AAMRL-TR-88-037

AD-A263 109

THE AAMRL BIODYNAMICS DATA BANK

TRUDY S. ABRAMS
Systems Research Laboratories, Inc.
2800 Indian Ripple Road
Dayton, OH 45440

INTS KALEPS
Modeling and Analysis Branch
Biodynamics & Bioengineering Division
Wright-Patterson Air Force Base, OH 45433-6573

JAMES W. BRINKLEY
Biomechanical Protection Branch
Biodynamics & Bioengineering Division
Wright-Patterson Air Force Base, OH 45433-6573

DECEMBER 1988

Summary Report for June 1984 to December 1988

Approved for public release, distribution is unlimited.

HARRY G. ARMSTRONG AEROSPACE MEDICAL RESEARCH LABORATORY
HUMAN SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433-6573

NOTICES

When US Government drawings, specifications, or other data are used for any purpose other than a definitely related Government procurement operation, the Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise, as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto

Please do not request copies of this report from Air Force Aerospace Medical Research Laboratory Additional copies may be purchased from

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

Federal Government agencies and their contractors registered with Defense Technical Information Center should direct requests for copies of this report to

Defense Technical Information Center
Cameron Station
Alexandria, Virginia 22314

TECHNICAL REVIEW AND APPROVAL

AAMRL-TR-88-037

This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS) At NTIS it will be available to the general public including foreign nations

This technical report has been reviewed and is approved for publication

FOR THE COMMANDER

JAMES W. BRINKLEY
Director
Biodynamics & Bioengineering Division
Harry G. Armstrong Aerospace Medical Research Laboratory

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved OMB No 0704-0188

1a REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3 DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.
2b DECLASSIFICATION/DOWNGRADING SCHEDULE	
4 PERFORMING ORGANIZATION REPORT NUMBER(S)	5 MONITORING ORGANIZATION REPORT NUMBER(S) AAMRL-TR-88-037
6a NAME OF PERFORMING ORGANIZATION Systems Research Laboratories, Inc. 6b OFFICE SYMBOL (If applicable)	7a NAME OF MONITORING ORGANIZATION HSD, AFSC, Harry G. Armstrong Aerospace Medical Research Laboratory, AAMRL/BBM
6c ADDRESS (City, State, and ZIP Code) 2800 Indian Ripple Road Dayton OH 45440-3696	7b ADDRESS (City, State, and ZIP Code) Wright-Patterson AFB OH 45433-6573
8a NAME OF FUNDING/SPONSORING ORGANIZATION AAMRL 8b OFFICE SYMBOL (If applicable) BBM	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER F33615-85-C-0530
8c ADDRESS (City, State, and ZIP Code) Wright-Patterson AFB OH 45433-6573	10 SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO 62202F; PROJECT NO 7231; TASK NO 23; WORK UNIT ACCESSION NO 02

11 TITLE (Include Security Classification)

THE AAMRL BIODYNAMICS DATA BANK (U)

12 PERSONAL AUTHOR(S)

Trudy S. Abrams, Ints Kaleps, James W. Brinkley

13a TYPE OF REPORT	13b TIME COVERED	14 DATE OF REPORT (Year, Month Day)	15 PAGE COUNT
Summary	FROM Jun 84 TO Dec 88	1988 December	72

16 SUPPLEMENTARY NOTATION

17. COSATI CODES			18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Bioengineering, Biodynamics, Data, Bibliography
23	01		
23	02		

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

This report traces the development of the Harry G. Armstrong Aerospace Medical Research Laboratory (AAMRL) Biodynamics Data Bank from the original concept of a National Biomechanics Data Bank proposed by Working Group 87 of the National Research Council. It describes the structure and contents of the current Biodynamics Data Bank (BDB), gives sample records of each type, describes available documentation, illustrates its potential, and suggests further development.

20 DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	21 ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a NAME OF RESPONSIBLE INDIVIDUAL ROY R. RASMUSSEN, JR.	22b TELEPHONE (Include Area Code) (513) 255-3667 / 22c OFFICE SYMBOL AAMRL/BBM

DD Form 1473, JUN 86 Previous editions are obsolete

SECURITY CLASSIFICATION OF THIS PAGE

UNCLASSIFIED

PREFACE

The research work described in this report was performed for the Modeling and Analysis Branch, Biodynamics and Bioengineering Division, of the Harry G. Armstrong Aerospace Medical Research Laboratory at Wright-Patterson Air Force Base under contract numbers F33615-81-C-0500 and F33615-85-0530. The research was monitored by Mr. Roy R. Rasmussen, Jr. of the Modeling and Analysis Branch and was performed by Systems Research Laboratories Inc., a division of Arvin-Calspan. The technical contributions of Dr. Ints Kaleps of the Modeling and Analysis Branch and Mr. James W. Brinkley of the Biomechanical Protection Branch were made under workunits 72312302 and 72312401 respectively.

The authors also acknowledge the help given to this project by the personnel of the AAMRL Biomechanical Protection Branch (AAMRL/BBP), the personnel of ASD/AD Information Central (Infocen), and the personnel of Dyncorp, contractor for AAMRL/BBP under contract numbers F33615-83-C-0500 and F33615-86-C-0531.

TABLE OF CONTENTS

SECTION **PAGE**

1. INTRODUCTION

In the late 1970s the Committee on Hearing, Bioacoustics, and Biomechanics (CHABA) of the National Research Council assembled an impressive body of biomechanical and biomedical scientists, gave them the expedient if nondescript title of Working Group 87 (WG87), and charged them with investigating the feasibility and defining the best attributes for a national biomechanics data bank [3]. The final report that appeared in early 1981 noted that the concept and rationale for such a data bank was originally offered by Dr. Henning von Gierke at a February 1977 Symposium on Biodynamic Models and their Applications. Dr. von Gierke stated that:

> . . .it appears essential that the material properties and mechanical characteristics fed into the mathematical models be based on all the relevant data available, and not on a few test results from an individual investigator. In view of the time, cost, and risk involved in obtaining this broad spectrum of experimental data, I think consideration should be given to the establishment of some kind of centralized national data bank that would store: a) directly measured mechanical properties of human tissue, b) mechanical properties of tissues of animals most frequently used in biodynamics research, c) human injury/rupture information derived from accident analysis, d) human tissue/organ response characteristics derived from volunteer biodynamics tests, e) human body dynamic response data from volunteer tests, and f) animal body subcritical and critical response data. This data bank should be fed by all laboratories working in this field and its data should be generally available. In this way, model parameters and inputs could be compared to the best and, above all, to all types of response data available. Such orderly collection of available data will also pinpoint gaps in our knowledge and could define the type and specify the format of data still missing.

The members of WG87 were in unamimous agreement on the concept and feasibility of a national biomechanics data bank and made several recommendations concerning its implementation [3]. These recommendations were evaluated by the Air Force in light of more recent developments in data management, the current scope and diversity of biomechanics research with respect to Air Force requirements, and with the aim of fulfilling the basic objectives of the CHABA working group as much as possible [2]. Specifically, for the effort finally undertaken at the Air Force Aerospace Medical Research Laboratory (AFAMRL, now the Harry G. Armstrong Aerospace Medical Research Laboratory, AAMRL) it was decided that:

> (1) The data bank should contain both experimental data and bibliographic data concerned with biomechanics and related physiology.
>
> (2) The data should be available to the biodynamics research community at large, and therefore must be supported by a powerful retrieval system and provided in a format that is easily understood by, and useful to, the entire biomechanics community.
>
> (3) Because conventions concerning nomenclature, units of measure, coordinate systems, etc. vary to a certain extent even within this community, the data should be accompanied by definitions, when needed to interpret the data.

(4) The design of the experimental subgroups (or files) should encompass several aspects of biodynamics research, so that a comprehensive view of each effort and its results is provided.

(5) Most importantly, the quality and internal consistency of the data must be held to high standards of accuracy and must be verifiable.

During 1980 to 1982 a feasibility study took place, as well as evaluations of various data base management systems (DBMS) and existing resources within the Air Force. The most appropriate path, it seemed, was to establish the Biodynamics Data Bank (BDB) as one of the databases maintained by Infocen (Information Central), a division of the ASD Computer Center at Wright-Patterson Air Force Base. Infocen, providing complete database services to Department of Defense (DoD) organizations on a cost-reimbursable basis, was already using a powerful data base management system called BASIS on clustered VAX 11/780 computers. Additionally, BASIS had originally been recommended as a most suitable DBMS for the AAMRL Biodynamics Data Bank in the Air Force Feasibility Study [2].

The AAMRL Biodynamics Data Bank began with one large set of bibliographic records modeled after the Defense Technical Information Center (DTIC) database. In 1984, using paper records and documentation from impact acceleration experiments performed at the Biomechanical Protection Branch of the AAMRL from 1972 onward as prototype material, a comprehensive design utilizing several record formats was developed and implemented to accomodate experimental data as well.

The current Biodynamics Data Bank, viewed a decade after the CHABA working group developed the concept and rationale for a national biomechanics data bank, fulfills the original critical objectives and goes beyond those early expectations in terms of scope and flexibility. A description of its organization, content and capabilities forms the body of this report

2. DESCRIPTION of the BIODYNAMICS DATA BANK

2.1. Basic Design Objectives

Although the Biodynamics Data Bank was designed around specific data, the goal was to create a *general* scientific data bank whose structure was generic enough to fit the results of any scientific experiment (particularly those in the biosciences) insofar as was possible, without compromising the effectiveness of the specific goal-- a repository for data from impact acceleration biodynamics experiments To that end, these observations were made and noted:

(1) A single, basic set of attributes applies to all scientific studies. The specific values of these attributes define a study's concerns and scope and provide an overall description of the study These attributes are such things as the title or name of the study, the objectives, investigators, facilities or laboratory, materials, instrumentation and equipment, number of individual tests performed, results, etc.

(2) Another set of descriptive or identifying attributes generally applies to all individual tests in a study, but whereas some apply universally (such as test number), and some apply universally for particular areas of research (such as test subject identification and weight, impact acceleration direction, etc.), many test attributes will not be the same from study to study, even within a particular laboratory, simply because each study poses different questions and therefore has different input and output variables.

(3) In-depth scientific studies result in quantitative results, that is, produce numeric output, and usually vast quantities of numeric output, even for a single test.

(4) Today's measurement technology has itself spawned an added dimension in record-keeping in terms of the necessity for providing the means of fully characterizing the data-gathering procedures, substantiating the validity of the data, and repeating the tests if necessary. Mechanical, electronic, and perhaps photometric or chemical attributes of the *devices* used to perform the experiment need to be stored in an accessible manner to provide a complete description of the test, the test data, and the total experiment.

(5) For the biomedical sciences, more detailed descriptions of individual human test subjects are as important a record as those concerning the other experimental devices.

To the above observations concerning the data were added the following requirements concerning the data bank design:

(1) Longevity-- non-obsolescence as far as possible-- is important for an undertaking of this magnitude.

(2) Researchers with diverse purposes must be served in such a way that none are forced to wade through an unreasonable amount of information that is not of interest to them to get to information that is

The following uses, though not exclusive, were particularly envisioned:

(1) A means of quickly identifying the objectives, scope, date, results, technical literature, etc. associated with a complete study; or of identifying studies with particular objectives, input parameters, results, etc.;

(2) an aid in the generation of technical reports, tables of summary information, etc., for the study whose data was stored,

(3) a means of identifying a set of tests with specific (experimental) input or output parameters, having potential for serving a new analysis, or for providing human response criteria and input and comparison data for mathematical models, regardless of the study or studies for which they were run;

(4) a means of quickly generating a bibliography for specific biodynamics areas, especially one representing literature emanating from experiments documented in the BDB and/or readily available at AAMRL libraries;

(5) a means of retaining and of retrieving in-depth anthropometric data for all human subjects of the biodynamics experiments, and of tracking their participation; or of identifying subjects with specific anthropometric characteristics and the tests in which they participated;

(6) a means of identifying a set of tests with specific *technical* input or output parameters having to do with the test facility, instrumentation or equipment, to aid in output data verification or correction, and in facility, instrumentation or test equipment (re)design

It should be emphasized that the BDB, while it has the potential for holding raw (digital) data representing the complete results of smaller-scale experiments, has as its original and primary purpose to fully *index*, and to provide extensive and complete *descriptive* and *summary* data for, large-scale biodynamics experiments generating time histories of 1/2 to 2 megabytes of electronic data for each test. These time histories and the digitized photometric data from each test are not stored in the BDB. What is stored is the information necessary to identify raw test data files of interest and the paths leading to them. The powerful retrieval system of the BDB can give definitive and complete answers to many questions concerning the biodynamics experiments currently represented there. It *identifies*, but does not give *direct* access to, all the raw data from those experiments.

2.2. Qualitative Content (Data Attributes)

The BDB is organized, somewhat hierarchically and somewhat relationally, into six main record types. Records of the same type, that is, which have the same format and the same kind of data, are designated with the same "file number". The contents of these six main record types (*files*, in BASIS terminology) are described in detail in the following sections, as are their relationships to each other. Briefly, they are:

(1) The STUDY or Experiments file, each record of which provides a fairly lengthy synopsis or overview of one complete study (Section 2.2.1.).

(2) the TEST INDEX file, each record of which describes briefly the identifying features and the primary input and output conditions of one test (Section 2.2.2);

(3) the TEST DATA file, each record of which gives numeric summary data for the responses from one test (Section 2.2.3.);

(4) the TEST LOG file, each record of which gives facility, equipment, and instrumentation characteristics for one test (Section 2.2.4.),

(5) the ANTHROPOMETRY file, each record of which gives detailed anthropometry for one human test subject (Section 2.2.5).

(6) the BIBLIOGRAPHY file, each record of which represents an abstracted biodynamics or biomedical citation (Section 2.2.6).

2.2.1. The Study or Experiments Record Type (Parent Record)

Each record of this type gives a synopsis or overview of one complete experiment or study, including descriptions of the individual test variables and technical parameters. Each parent record thus provides, in addition to its own housekeeping information and self-identification, the following data for a study:

(1) The study's program code identification-- **project, task, work unit numbers**;

(2) the **title** of the experimental effort;

(3) the **investigators**-- persons responsible for conducting the study;

(4) the time period of the study, represented by **testing start and testing end dates**;

(5) the **current contact**-- an up-to-date name, address and phone number of the person who has access to all historical information and should be able to answer questions about the study;

(6) the **technical report number**, for studies, like those performed at government institutions, which result in a comprehensive written report;

(7) **protocol numbers** which identify the generic and specific protocols used in the study if human subjects participated;

(8) **key words** which do not appear in the title but might be used to reference the study's concerns;

(9) the study's specific **objective or objectives**, which may be phrased as a hypothesis or a set of related hypotheses;

(10) a brief description of all **test matrix cells**, or categories of investigation for the study, including control groups,

(11) the matrix element **peaks and ranges** for the entire study, if they exist-- such things as peak input acceleration at a particular velocity, maximum height and weight, or temperature range, etc., if applicable;

(12) a general list of **measured variables** for the study,

(13) the test **facility, facilities, or particular laboratory** used for the study-- for example, the AAMRL Horizontal Impulse Accelerator, the Vertical Deceleration Tower, or the Anechoic Chamber;

(14) a general list of **instrumentation** used-- for example, triaxial accelerometers, strain gauge load cells, etc.

(15) a list of **incidental equipment** used in the study such as subject clothing or protective gear, or physiological monitoring equipment not considered as necessary for determining the results of this particular study;

(16) the **total number of tests** involved in the study, whether run originally for that study or "adopted" from another, including tare tests and other set-up tests, but including a number for the total tests used in the analysis;

(17) an indication of the data **analysis technique(s)**, if any were used, such as ANOVA or Wilcoxon paired-replicate rank test;

(18) a brief summarized statement of **results or conclusions**, or several paragraphs if necesary, qualitative or quantitative in nature, depending on the study;

(19) general **pointers to the raw data**-- what media is used to store it and where it's stored, etc.;

(20) a list of the original **identifying numbers of all tests** run for that study or used in the study;

(21) a list of **remarks and definitions** to help interpret the data and having to do with the study as a whole, that is, all tests in the study, such as the coordinate system used, etc ;

(22) a list of the **variables in the Test Index records, and their mnemonic locations**, "belonging" to this parent-- that is, representing tests run specifically for this study;

(23) a list of the **variables in the Test Data records, and their mnemonic locations**, "belonging" to this parent-- that is, representing those same tests; and

(24) a list of the **variables in the Test Log records, and their mnemonic locations**, "belonging" to this parent-- that is, representing those same tests. (This last attribute actually appears on an *extension* of the parent record.)

2.2.2. The Test Index Record Type (Child Record)

Each record of this type gives a synopsis or overview of one test, including its identifying information and input parameters. Unlike the parent record, the variable names of all child records are "fluid"-- they can change for each study. (More on this in the following sections.) However, the identifying information and input variables for impact acceleration tests tend to remain fairly stable. Most Test Index records now in the BDB contain, in addition to their own "housekeeping" information, the following variables:

(1) The original **test number**, including an AAMRL facility acronym such as VDT (for Vertical Deceleration Tower) or HIA (for Horizontal Impulse Accelerator);

(2) the **parent record accession number**, which is the "family name" of the study for which this test was originally run;

(3) the test **cell** as defined in the test matrix of the parent record;

(4) the **subject type**, human or animal species, including the suffix -M or -F for gender;

(5) the unique, permanent **subject identification** code;

(6) the **peak acceleration direction** as defined by the coordinate system used in the study, such as +Gz, -Gx, etc.;

(7) any general **notes** or comments pertaining solely to that test or to the data from that test;

(8) a "yes" or "no" indicating the presence or absence, respectively, of a **negative-g strap** in the restraint system;

(9) a general **peak injury rating**, if such indices were used in an animal study;

(10) the **breed**, if the test subject was a non-human animal;

(11) direct links to **other parents** (other parent accession numbers), if this particular test was used in studies other than the one for which it was originally run;

(12) the **test date**;

(13) the **subject age**;

(14) the **subject weight**;

(15) the **subject height**;

(16) the **subject sitting height**;

(17) all **preloads**, given individually, for the restraint harness straps;

(18) the **peak acceleration** of the sled or carriage;

(19) the **maximum velocity** of the sled or carriage;

(20) the **time of the maximum velocity** from a defined zero-- an indication of when impact occurred,

(21) the **event (impact) duration**;

(22) the **Chest Severity Index** (CSI), one of several computed values used as indicators of likely injury;

(23) the **Head Severity Index** (HSI);

(24) the **Head Injury Criteria** (HIC);

(25) the **Dynamic Response Index** (DRI).

The Test Index record has other available generic slots (fields) and can accept any variable that is considered a descriptor for that test. Some current Test Index records also include **severity** and/or **injury indices for second subjects** (for two-passenger impact tests). Others have the **seat elevation** and/or the **average reel strap angle**, if those were input variables for that study. Variables for Test Index records of a study where a facility itself was under investigation are descriptive of the facility's initial conditions and final performance-- input settings, output pressures, etc. In short, the Test Index record provides information, other than the full set of output measurements, which describes a test and thereby distinguishes it from, or matches it with, other tests of the same or similar studies according to any number of test criteria.

2.2.3. The Test Data Record Type (Child Record)

Each record of this type gives numeric output data for one test-- complete, if feasible, or in summary form-- arranged in a multidimensional numeric array. The variable names, like those of the other child records, are fluid-- they can change for each study, though again, for impact acceleration tests they tend to remain fairly stable for a given facility. As an example of the data stored in this record type, a large number of records now in the BDB represent tests run on the AAMRL Vertical Deceleration Tower (VDT) and contain, in addition to their own housekeeping and self-identifying information, the following variables:

(1) The original **test number**, including the AAMRL facility acronym, which matches the test number of the Test Index record for this test;

(2) the **parent record accession number**, the family name of the study for which this test was originally run;

the impact maximum, time of impact maximum, impact minimum, time of impact minimum and preimpact average, for each of the three orthogonal axes and their resultant if triaxial instrumentation was used, or for a single measurement if one-dimensional instrumentation was used, for

(3) the carriage acceleration;

(4) the seat acceleration;

(5) the chest acceleration;

(6) the head acceleration,

(7) the total shoulder strap load;

(8) the left, right and total lap loads,

(9) the left, right, center and sum seat link loads,

(10) the left, right, center and sum seat loads,

(11) the negative g-strap load;

(12) the left, right, center and sum foot loads;

(13) the left, right and total reflexion shoulder strap loads,

(14) the left, right and total reel shoulder strap loads,

(15) the total left shoulder load;

(16) the total right shoulder load;

(17) the foot plate acceleration;

(18) the thorax (back) acceleration,

(19) a tare-corrected seat load; and

(20) seat, chest and head angular accelerations

Test Data records representing tests run on other facilities will have slightly different variables. In short, variables of this record type, for impact acceleration studies, represent maxima and minima of the time histories for each individual measured response.

2.2.4. The Test Log Record Type (Child Record)

For the impact acceleration tests now represented in the BDB, these are the largest records in terms of the total number of variables represented in the record's fields and subfields. Each record of this type gives mechanical, electronic and photometric information about the facilities, equipment and instrumentation used in the study, and

pointers to the raw data and to the programs used to process the data The following variables are currently represented as fields or subfields in Test Log records.

(1) The original **test number**, including the facility acronym, which matches the test number of the Test Index and Test Data records for this test,

(2) the **parent record accession number**, the family name of the study for which this test was originally run;

(3) **notes** and comments pertaining to all of the test's technical parameters,

(4) **manikin identification** more explicit than that given in the subject identification field of the Test Index record,

(5) mechanical or hydraulic settings, identification, or output characteristics for the significant components of the facility, given individually--

for the Horizontal Impulse Accelerator, e g , the **metering pin number, sled brake pressures, set** and **load pressures, trigger pressure, set** and **load volume lengths, load chamber temperature, ram displacement** and **sled travel**,

for the Vertical Deceleration Tower, e g., the **plunger number, nose number, sleeve number, mandrel type**, the **orifice diameter, water height** and **drop height;**

(6) **restraint type and description**, including material, configuration, model or style numbers, etc,

(7) **restraint attachment locations**, as coordinates if available,

(8) any **ballast locations and descriptions,**

(9) specific **descriptions** (model numbers, etc.) **of other protective equipment** such as helmets, seat cushions, etc ;

(10) the **seat type** and **seat assembly drawing number**;

(11) the **headrest type** and **headrest position**,

(12) **load cell locations**, as coordinates if available;

(13) notes on any recent **facility alteration or inspection**.

(14) the impulse/impact characteristics such as **waveform**, **rise time, event duration**, and **peak acceleration**;

(15) the **objective peak acceleration, objective impact velocity**, and **objective impact duration**,

(16) **ambient temperature** and **relative humidity**.

(17) the **average reel strap angle** of the subject's harness;

(18) the **seat weight**, the **seat height**, the **seat pan inclination angle**, and the **seat back angle**;

(19) **ballast weight** or weights;

photometric parameters which include

(20) **lights on** and **off** times; individual **camera on** and **off** times; and other timing, status and camera voltage supply information;

(21) all **fiducial locations**, as coordinates if available,

(22) each **camera location and description**, given individually and including camera models, serial numbers, lens size, shutter speed, etc ;

(23) other **camera** or **light control** or **status** settings;

parameters for the instrumentation and supporting electronics which include

(24) a list of **channel assignments**, indicating which data channel was used for each measured variable;

(25) a list by data channel of each **transducer's identification** (manufacturer and model number), **serial number, sensitivity** and **full-scale value**;

(26) a list by data channel (or the values for all channels with like values) of the **transducer zeros** and **ranges**;

(27) **excitation volts** for each or for all channels;

(28) a list by data channel of the **filter identification** (series and serial number) and **sensitivities**;

(29) the **sampling rates** for each or for all data channels;

(30) a list by data channel of the **amplifier serial numbers** and **gains**,

(31) a list by data channel of the **bridge resistor information**--balance voltage, ground direction and completion voltage;

(32) a list by data channel of the **voltage control oscillator identification**;

(33) a list of **multiplexer identification** and **channels**;

(34) a list of **tape recorder channels** and **types**,

(35) **computer** and **facility on** and **off** times.

(36) **magnetic tape on** and **off** times and **speed**;

(37) a special **note** field for **electronic problems**;

data processing and analyzing information which includes

(38) photometrics **tape identification**;

(39) processing **program names**,

information to help link the measured response data to the photometric data, such as

(40) the **number of frames** processed; the **number of frames from the event**, the **number of frames from the timing bar**; and the **number of frames from the flash to the timing bar**;

(41) **status** (mode) information for the **event flash** and **timing bar**,

(42) the **reference mark** (time) and **impact start time.**

As with the other child record types, the variables described above do not comprise a list that is exhaustive, or exclusive, or mandatory. Whatever mechanical, electronic, photometric or data processing information is available to describe, validate or enable reproduction of the tests may be stored in this file of the BDB.

2.2.5. The Anthropometry Record Type

Each of these records represents one human test subject on a given measurement day. Besides the standard self-identifying and housekeeping information, each record can currently provide the following:

(1) The unique **subject identification** code, which matches the subject identification code on Test Index records representing tests in which this subject participated,

(2) a list of the **protocol numbers** which identify the generic and specific human protocols under which the subject served, and which match protocol numbers in the appropriate Study records;

(3) the **measurements date**;

(4) the subject's **age** on that day,

(5) the subject's **date of birth**,

(6) the subject's **sex** (gender);

(7) the subject's **weight, height,** and **sitting height**,

nineteen anthropometric values considered for convenience as belonging to the head segment of the body which include

(8) the aorta-eye length;

(9) the cervicale height;

(10) the eye height;

(11) the eye height, sitting;

(12) the eye height, sitting, up;

(13) the eye height, sitting, down,

(14) the head breadth;

(15) the head circumference,

(16) the head length,

(17) the infraorbitale-nuchale length;

(18) the infraorbitale-tragion length;

(19) the mastoid height;

(20) the neck breadth,

(21) the neck circumference;

(22) the nuchale-T1 length;

(23) the tragion-T1 length;

(24) the chin or neck height,

(25) the top of the head-to-tragion length;

(26) the wall-to-tragion length;

seventeen anthropometric values considered for convenience as belonging to the upper torso segment of the body which include

(27) the acromion height;

(28) the acromion height, sitting;

(29) the biacromial breadth,

(30) the bideltoid breadth;

(31) the chest circumference;

(32) the chest depth;

(33) the **mid-shoulder height, sitting,**

(34) the **subscapular skinfold;**

(35) the **tenth rib breadth;**

(36) the **tenth rib circumference;**

(37) the **tenth rib height,**

(38) the **waist breadth,**

(39) the **waist circumference;**

(40) the **aorta height;**

(41) the **chest breadth;**

(42) the **suprasternal height;**

(43) the **shoulder circumference;**

twenty-two anthropometric values considered for convenience as belonging to the arm-hand segment of the body which include

(44) the **acromion-radiale length;**

(45) the **axillary arm circumference;**

(46) the **biceps circumference, flexed;**

(47) the **dactylion height;**

(48) the **elbow circumference, extended;**

(49) the **elbow-grip length;**

(50) the **elbow rest height, sitting;**

(51) the **functional reach;**

(52) the **functional reach, extended;**

(53) the **hand breadth;**

(54) the **hand circumference;**

(55) the **hand length;**

(56) the **metacarpal III-dactylion length;**

(57) the **mid-forearm circumference;**

(58) the **radiale-stylion length;**

(59) the **shoulder-elbow length**,

(60) the **triceps skinfold**;

(61) the **wrist circumference**;

(62) the **acromion-dactylion length**;

(63) the **ball of the humerus to radiale length**;

(64) the **wrist breadth**,

(65) the **elbow breadth**;

eight anthropometric values considered for convenience as belonging to the lower torso segment of the body which include

(66 the **anterior-superior iliac spine height**;

(67) the **buttock circumference**;

(68) the **gluteal furrow height**;

(69 the **hip breadth, sitting**;

(70) the **iliac crest height**;

(71) the **suprailiac skinfold**;

(72) the **trochanterion height**;

(73) the **bispinous breadth**;

twelve anthropometric values considered for convenience as belonging to the leg-foot segment of the body which include

(74) the **ankle circumference**;

(75) the **buttock-knee length**;

(76) the **calf circumference**;

(77) the **calf depth**;

(78) the **foot length**,

(79) the **knee height, sitting**;

(80) the **mid-thigh circumference**;

(81) the **sphyrion height**;

(82) the **tibiale height**;

(83) the **upper thigh circumference**,

(84) the **lateral malleolus height**,

(85) the **femur breadth**; and

(86) any **comments** about the anthropometric values, special characteristics of the subject, or the measurement procedure.

2.2.6. The Bibliography Record Type

The bibliographic records of the BDB represent literature arising from biodynamics experiments conducted at AAMRL, or at related laboratories such as those of other DoD or DoT (Department of Transportation) organizations, or at organizations under contract to the DoD or DoT. Additional citations in this file represent literature available at one of the local Biodynamics and Bioengineering Division libraries, and thus considered highly relevant to biodynamics and bioengineering research.

In addition to its own housekeeping information, each record in the Bibliography file now may provide

(1) the **document type** in its final format, such as journal article, book chapter, memorandum, etc.;

(2) the **title** in English,

(3) the human **author(s)** of the literature;

(4) the remaining **citation**, that is, the journal name, volume, pages, date; or the words *Proceedings of* followed by the meeting name, place and date; or the book publisher and date; or the Report Number; etc;

(5) the **source** of the research on which the literature is based, usually a research institution or company,

(6) the **date** of the publication, usually the same as appears within the citation, but given separately as a numeric field to allow for chronological sorting or selection;

(7) the total **number of pages** in the document,

(8) **descriptors** or keywords not found in the title or abstract but sometimes provided with a published report or article that might be useful in identifying subject content;

(9) an **abstract** in English;

(10) an in-house acronym indicating which AAMRL library has a copy of the document **available**, sometimes followed by a parenthetical phrase indicating the state of the available copy (Draft, e g.),

(11) any post-publication **codes** used to identify the publication, such as a DTIC access code or a library code,

(12) the **parent record accession number** or family name of the study from which the literataure arose, if the study is represented in the BDB;

(13) a **note** field containing, e.g., the original foreign language title or any other pertinent comment,

(14) information on **when** and **by whom** the BDB record was **originally input**; and

(15) a field repeating the **first author**'s name in a directory style format for sorting purposes

2.3. Structure and Format

2.3.1. Driving Requirements

The basic design objectives described by the observations, requirements, and envisioned uses of the AAMRL BDB mentioned in Section 2 1. generated the following driving requirements for determining structure and format:

(1) The need for **flexibility in the attributes of the experimental data,** which could be fulfilled by a certain open-endedness and generic quality to the variable slots-- the option of using *more* fields when needed or of *changing* the field descriptions of the child record types and the Anthropometry record type;

(2) the need for **flexibility in the retrieval process**, fulfilled by a series of logical and virtual *links* between different record types related to each other in some way; and

(3) the sheer **magnitude of the volume of experimental data**-- thousands of individual pieces of data about each study, each test, and each test device, which strained the capacity of the data base management system and the user's ability to retain and recall mnemonic field names.

2.3.2. Special Contrivances

Although BASIS is a powerful main-frame DBMS with several outstanding qualities, its capabilities were challenged by the objectives and requirements of the AAMRL Biodynamics Data Bank. Its flexible format of variable length records and variable length fields, and its enormous capacity-- a possibility of 2,000 fields per data base organized into any number of record types (files) with a maximum of 15,800 characters per record on the VAX-- were most valuable. But the BDB data is both hierarchical and relational in quality, and BASIS is inherently neither. The response to the driving requirements listed above, and to BASIS's capabilities and limitations, produced some innovative design concepts and contrivances.

(1) The Study record, providing information pertaining to all tests performed in the study, is seen as the parent of all three Test record types, and of any Bibliography records which cite literature produced from that study. Its own unique accession number is affixed as a family name to all such related records, that is, all three Test record types (the children), and the appropriate Bibliography records.

(2) Because test variables can change from study to study, all field names in the test record types are generic-- Test Index variable names *can* be F2E01 through F2E99, Test Data variable names can be F3E1 through F3E3(r,s,t,...w) where up to six dimensions may be represented as subfields, and Test Log variable names can be F4E001 through F4E549. For each record type more generic names exist than are needed for studies currently in the BDB or projected for the near future.

The "F" in these mnemonic names stands for "file" and is followed by the BASIS file number (2, 3, or 4) designating Test Index, Test Data and Test Log records respectively. The "E" stands for "element", used here instead of the word "field" to distinguish the number which follows it from actual BASIS field numbers. Test Index element numbers are all double-digit, Test Data element numbers are all single-digit, and Test Log element numbers are all triple-digit.

(3) The parent record (along with its extension) provides, as part of its own data, three lists which indicate how the generic slots of each child record type are assigned for that study. That is, each list has generic field names on the left and specific, logical test variable names on the right. [See (22), (23), and (24) of Section 2.2.1.]

(4) Although the specific, logical test variable names can change from study to study, they are always assigned to generic field names consistently. For example, in Test Index records, the Cell, if it exists, is *always* assigned to F2E02 and the Subject Identification is *always* assigned to F2E04.

(5) Each such list in the parent record, or in its extension described in item (8) below, provides a summary of Test Index, Test Data, or Test Log variables for the study, and where to find the data for each variable (i.e., in which field of the child record) But also, the right hand side of the list, which contains the true (logical) test variable names, can be exploited by special run modules-- subroutines which, when called, "lift" the appropriate variable names from the proper parent record and display it with the data. Such a run module has been written and is functional for Test Index variables. An analogous one for Test Log variables is being written. This means that the user can type an easily remembered mnemonic like F2E05 when wishing to select or display the Peak Acceleration Direction, for example, but that the data will be displayed with the *label,* PEAK ACCEL DIRECTION.

(6) A special relationship, or link, exists among the three child records of different types (Test Index, Test Data and Test Log) which provide data for the *same test.* These records will not only contain identical data in their respective Parent Accession Number fields, but also will

contain identical data in their respective Test Number fields While all test records of a given parent (Study) may be referred to as "siblings", these specially related siblings, when spoken of two or three at a time, are referred to as "twins" or "triplets".

(7) The parent-child or family analogy is carried one step further to allow for the frequent instances when the same test is used for more than one study. The Parent Accession Number that appears in all Test Index, Test Data and Test Log records refers to the "natural parent". It identifies the study for which that test was *originally* run. Another field in the Test Index record might contain the accession numbers of other Study records, known as "adoptive parents", if data from that test was analyzed later to answer other hypotheses. Thus, to fully characterize a study, the Total Number of Tests and Test Numbers, two attributes (fields) of each Study record, might include not only all natural children, but also adoptive children. However, only the natural children records would contain that Study record's accession number in their Parent Accession Number fields.

Two special structure/format contrivances, described in (8) and (9) below, help organize and facilitate the use of Test Log data.

(8) The Parent Extension, which has already been mentioned briefly, is the seventh record type and performs the same function as each of the last two *fields* of the parent record. It contains the list of Test Log variables and their mnemonic locations. [See item (24) in Section 2.2.1.] Thus, while the Test Index variables list and the Test Data variables list really occupy *fields* in the Study (parent) record type, the Test Log variables list actually appears in a separate *record*

This format not only provides the room needed for the large amount of data comprising the Test Log variables list (this variables list, if it *were* in a field of the parent record, would push the total number of characters in the parent record far past the 15,800-character limit), it also provides a "blow-up" of the functional entity and the opportunity for another level of organization That is, since the Test Log variables list occupies a *record*, it itself can be (and is) divided into several groups, each of which occupies a separate *field*.

The Parent Extension record type is described in detail in Section 2.3.2.1.

(9) Additionally, there is the concept and existence of Common Test Log records-- records of the Test Log type, but whose data pertains not just to one test, as is the case with ordinary (variable) Test Log records, but to all the tests of the study done on the same facility. The data for Test Log parameters for which the data remained *constant* for every test in the study will appear in the Common Test Log record for that study. The data for Test Log parameters for which the data *varied* from test to test appears in the ordinary (variable) Test Log records for that study.

All Study records now in the BDB have one Common Test Log record for each *facility* used in the study and one variable Test Log record for each *test* run during the study. Thus, two Test Log records may be

(and usually are) used to provide the complete Test Log data for a single test-- the Common Test Log record for that facility and the specific (variable) Test Log record for that test. A special "test number" identifies Common records.

(10) The flexibility required of the Anthropometry record format is of a different nature While the set of anthropometric measurements might change from time to time or from study to study, the complete file (i.e., *all* Anthropometry records) has to remain an entity. That is, unlike the variable slots of the Test record types which can be (and need the option of being) reassigned for a radically different biodynamics study, each slot of the Anthropometry file, once assigned to an anthropometric variable, needs to remain so. Therefore, no special run modules are needed to generate meaningful labels for data display; the true variable name is part of the Database Definition and will appear in BASIS displays. However, an open-endedness is still required, inasmuch as new (different) anthropometric measurements may be added, and frequently are, for different studies from time to time. Further, the great number of variables in this file [See Section 2 2.5] and the complexity of the individual variable names (i e., the measurement descriptions) makes useful mnemonic field names based on those descriptions unfeasible.

These problems are solved by another special record type, the eighth record type in the current BDB, called the ANTHROPOMETRIC MEASUREMENTS DIRECTORY. This single record is, as its name implies, a directory of general subject characteristics and anthropometric measurements divided for convenience into five body segments. General subject characteristics and all the anthropometry measurement descriptions, listed alphabetically, are within those six groups, along with an Anthropometry record mnemonic (generic) field name for each. A new measurement definition and a new Anthropometry record field name can be added as new data to the apropriate field of the Directory at any time.

2.3.2.1. The Study (Parent) Extension Record Type

The reason for the existence of this special record type has been given in item (8) of Section 2 3.2. It contains, besides its own self-identifying and housekeeping information, a list of the variables in the Test Log records belonging to the parent of which this is an extension and their mnemonic locations. It provides this information by dividing the list appropriately among the following attributes or fields:

(1) **The parent record accession number** of which *this* record is a logical extension;

(2) **general Test Log variables**, a list containing any of the relevant Test Log mnemonic field names (F4E001 through F4E010, reserved for general parameters) and their actual variable names such as TEST NUMBER, PARENT ACCN NUMBER, and NOTES;

(3) **variable (non-constant) mechanical Test Log variables**, a list containing any of the relevant Test Log mnemonic field names

(F4E090 through F4E199, reserved for mechanical Test Log parameters) and their actual variable names such as RESTRAINT TYPE or ORIFICE NUMBER, if the data for these mechanical variables changed from test to test (or, at least, did not remain constant for the entire study),

(4) **constant mechanical Test Log variables,** a list containing any of the relevant Test Log mnemonic field names (F4E090 through F4E199) and their actual variable names, if the data for these mechanical variables did not change from test-to-test (remained constant) and thus appears in a Common Test Log record for that study;

(5) **variable (non-constant) photometric Test Log variables,** a list containing any of the relevant Test Log mnemonic field names (F4E300 through F4E379, reserved for photometric Test Log parameters) and their actual variable names such as CAMERA DESCRIPTIONS or FIDUCIAL LOCATIONS, if the data for these photometric variables changed from test to test (or, at least, did not remain constant for the entire study),

(6) **constant photometric Test Log variables,** a list containing any of the relevant Test Log mnemonic field names (F4E300 through F4E379) and their actual variable names, if the data for these photometric variables did not change from test to test (remained constant) and thus appears in a Common Test Log record for that study,

(7) **variable (non-constant) electronic Test Log variables,** a list containing any of the relevant Test Log mnemonic field names (F4E400 through F4E479, reserved for electronic Test Log parameters) and their actual variable names such as CHANNEL ASSIGNMENTS or BRIDGE RESISTOR INFO, if the data for these electronic variables changed from test to test (or, at least, did not remain constant for the entire study);

(8) **constant electronic Test Log variables,** a list containing any of the relevant Test Log mnemonic field names (F4E400 through F4E479) and their actual variable names, if the data for these electronic variables did not change from test to test (remained constant) and thus appears in a Common Test Log record for that study.

(9) **variable (non-constant) raw-data-link Test Log variables,** a list containing any of the relevant Test Log mnemonic field names (F4E500 through F4E549, reserved for raw-data-link Test Log parameters) and their actual variable names such as NUMBER OF FRAMES FROM EVENT or PROCESSING PROGRAM NAMES, if the data for these raw-data-link variables changed from test to test (or, at least, did not remain constant for the entire study), and

(10) **constant raw-data-link Test Log variables,** a list containing any of the relevant Test Log mnemonic field names (F4E500 through F4E549) and their actual variable names, if the data for these raw-data-link variables did not change from test to test (remained constant) and thus appears in a Common Test Log record for that study.

It should be noted that each parent (Study) record will have one and only one Extension record associated with it. The link provided by accession numbers is two-way: The parent record accession number appears (as data) in the Extension record, and the Extension record accession number appears (as data) in the parent record.

2.3.2.2. The Anthropometric Measurements Directory

There is only one record of this type (with this file number designation and format) Besides its own housekeeping information it has six fields

(1) **General attributes** contains a list of Anthropometry record variables which describe general characteristics of the human or his/her participation as a test subject, such as Subject ID, Protocol Numbers, Measurements Date, Age at Measurements, Date of Birth, Sex, Weight, etc. Opposite each attribute is the mnemonic name of the Anthropometry record field (a true mnemonic abbreviation of the general attribute) which contains the corresponding data.

(2) **Head-Neck** is the field containing, as data, an alphabetized list of anthropometric measurements in the head-neck segment of the body. Opposite each is a generic mnemonic name of the Anthropometry record field (HEAD1, HEAD2, etc.) which contains the corresponding data

(3) **Upper Torso** contains an alphabetized list of anthropometric measurements from the upper torso region of the body. Opposite each is a generic mnemonic name of the Anthropometry record field (UPTOR1, UPTOR2, etc.) which contains the corresponding data.

(4) **Arm-Hand** is the field containing an alphabetized list of anthropometric measurements in the arm-hand segment of the body. Opposite each is a generic mnemonic name of the Anthropometry record field (ARM1, ARM2, etc.) which contains the corresponding data.

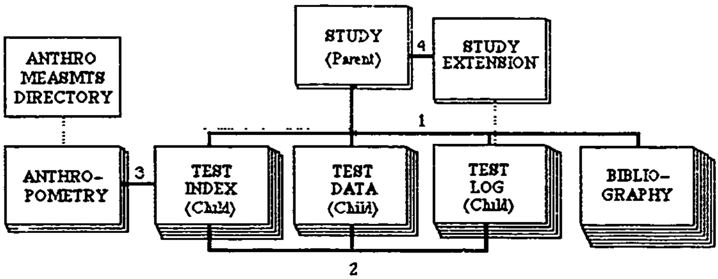
(5) **Lower Torso** contains an alphabetized list of anthropometric measurements from the lower torso region of the body. Opposite each is a generic mnemonic name of the Anthropometry record field (LOTOR1, LOTOR2, etc) which contains the corresponding data.

(6) **Leg-Foot** is the field containing an alphabetized list of anthropometric measurements in the leg-foot segment of the body. Opposite each is a generic mnemonic name of the Anthropometry record field (LEG1, LEG2, etc.) which contains the corresponding data.

The Anthropometric Measurements Directory serves a function analogous to that of the last two fields of each parent record and its extension inasmuch as it contains, as *its* data, a list of variable descriptions and mnemonic field names for *another* record type. But the Directory and the file of Anthropometry records are more stand-alone; none belongs to any particular study or any particular test. There is a relationship between Anthropometry records and Study records, because protocol numbers appear as data in each type. There is also, of course, a relationship between each Anthropometry record and any number of Test Index records, manifested through the subject identification code which appears in each record type.

2.3.3. Structure of the BDB, Relationships Between Record Types

The following diagram shows the structure of the Biodynamics Data Bank and the relationship between record types (files). The file thicknesses give a rough indication of their relative sizes. The dotted lines indicate "controlling" relationships, from record types whose contents (data) indicate the contents and specific locations of the contents of other record types.



(1) Study records each describe an investigation or experiment. An **accession number** assigned to this record becomes the family name of the study. It identifies and links all records representing tests that were a part of that study, and any bibliographic references to literature arising from that study.

(2) Each test may be represented by three record types: A Test Index record which gives the identifying parameters, a Test Data record which gives abbreviated characteristics of the responses, and a Test Log record which gives facility, equipment and instrumentation parameters. These records are linked to each other by the original **test number** which includes a facility acronym.

(3) For each human subject there may be one or more Anthropometry records, depending on how many occasions the subject was measured. A **subject identification** code links the record to each test in which that subject participated.

(4) Each Study (parent) Extension record performs the same function as the last two *fields* of the parent record which define the fields (variables) of the first two child record types The Extension record contains data which defines the fields (variables) of the third child record type. A double link exists between a parent record and its extension; each contains **the other's accession number** (in a data field) in addition to its own which appears, of course, in the housekeeping section of the record as its own unique identification.

2.4. Quantitative Content

The Biodynamics Data Bank currently contains a total of about 15,300 records About 5,250 of these are Bibliography records. About 3,250 additional Bibliography records are in off-line files being edited and are moved to on-line status periodically

There are 26 Study records in the BDB, data for a 27th study is currently being input but is not yet complete.

The total number of Test Index records is currently 4,731 and corresponds to the total number of tests performed for those 27 studies For each of these Test Index records, a Test Log record exists now or is being prepared, in addition to the Common Test Log records for each study. Test Data records are not available for all tests, some have not yet been prepared for input but will be, and some will never exist because the test was a tare test or a procedural check for which data was not gathered At this time there are 543 Test Data records in the BDB.

About 2,000 of the tests currently represented in the BDB involved human subjects, and almost 1,900 tests involved manikins The other test records (about 830) represent animal tests, or tests which did not involve a subject of any kind (e g., a facility check).

Four AAMRL impact facilities are represented in the BDB at this time. Most of the tests (2,510) occurred on the Horizontal Impulse Accelerator. Nine hundred and eleven took place on the Vertical Deceleration Tower, 789 on the Horizontal Decelerator, and 521 on the IMPAC Deceleration Tower. In total, these represent about 61% of all tests performed on those four facilities since 1972

2.5. Accessibility

The Biodynamics Data Bank is mounted on the VAX network maintained by Information Central (Infocen), a department of the ASD Computer Center at Wright-Patterson Air Force Base. It is known as DB57 and is one of about 80 databases maintained by that organization

Users access the BDB by connecting to the Infocen VAX system through a terminal-modem (or terminal emulator and modem) system and an ordinary telephone line. Infocen is also connected to the Defense Data Network. Once in the Infocen environment, the user is offered a range of menu items including Mail, Phone, File Transfer, Batch Processing, etc., as well as the BASIS Data Base Management System, through which the BDB is accessed

A working knowledge of BASIS is required The BDB User's Manual is designed to provide this knowledge for users interested in retrieving BDB data [4]

2.6. Sample Records

The following were generated with BASIS output commands by capturing the BASIS output on a Macintosh SE disk file while the Macintosh was connected via modem (with terminal emulator software Red Ryder) to the Infocen VAX. The text file was then opened as a Microsoft Word document and minor changes in spacing and font size were made before the sample records were incorporated into this report. Except for these changes, the records appear as they did during the download from the database

2.6.1. Study Records

These records were displayed with an ordinary BASIS DISPLAY command.

Item 1

FILE NUMBER.	001
ACCESSION NUMBER	1
DATE OF LAST UPDATE.	88/08/16
EXTENSION (F5) ACCN NO.	1663
PE/PROJ/TASK/WU.	62202F-7231-16AG
TITLE.	Effects of a Negative G Strap on Restraint Dynamics and Human Impact Response
INVESTIGATORS	Bernard F. Hearon, James W Brinkley, David M Hudson, William J Saylor
TESTING START	811130
TESTING END-	820622
CURRENT CONTACT-	James W Brinkley
CONTACT ADDRESS	AAMRL/BBP, WPAFB Ohio 45433
CONTACT PHONE:	(513)255-3931, Autovon 785-3931
TECH REPORT NO-	AFAMRL-TR-83-83
PROTOCOL NO-	81-40, 82-07
KEY WORDS-	Biomechanical Protection, Acceleration, PCU-15/P Torso Harness, Crotch or Anchor Strap, Vertical Seat Loads, Man-Seat Coupling, Torso Submarining, Volunteer or Human Subjects, Dummy or Manikin
OBJECTIVE(S)-	Assess influence of negative g strap on restraint dynamics and human impact response
TEST MATRIX	A Forward-facing impact (-Gx), PCU-15/P restraint, no neg g strap, B -Gx, PCU-15/P, with neg g strap, C -Gx, conventional restraint, no neg g strap, D -Gx, conventional restraint with neg g strap, E. Vertical impact (+Gz), PCU-15/P, no neg g strap, F +Gz, PCU-15/P, with neg g strap, G +Gz, conventional restraint, no neg g strap, H +Gz, conventional restraint, with neg g strap
MATRIX ELEMENT RANGES	Gx peak at 10 G, 30 fps +Gz peak at 10 G, 26 fps
MEASURED VARIABLES	Harness strap static preloads, harness strap loads; forces reacted at seat, triaxial translational acceleration components at seat, head, chest, displacements of photometric targets located at dental

appliance, cheek, shoulder, elbow, knee (left side), four targets on carriage for horizontal tests, and at dental appliance, elbow, shoulder (right), chest, lower helmet, upper helmet, six targets on fixture for vertical tests

FACILIT(IES)/LAB(S):	Horizontal Impulse Accelerator (HIA), Vertical Deceleration Tower (VDT), AAMRL/BBP, WPAFB
INSTRUMENTATION	Piezoresistive accelerometers, triaxial strain gauge load cells, triaxial translational accelerometer arrays, tachometer, strain gauge load links; ADACS (Automatic Data Acquisiton and Control System), DEC PDP 11/34 and CDC Cyber 74 computers (for data processing), high-speed 16 mm cameras, Automatic Film Reader system, DGC Nova 3/12 computer (for photometric data acquisition)
INCIDENTAL EQUIPMENT	Cut-off long underwear, athletic supporters for male subjects, disposable dental bite blocks (for mounting of head accelerometer array), EKG electrodes, telemetry and recorder, Instant Analytical Replay (INSTAR) video system For vertical impact tests, flight helmets.
TOTAL NO OF TESTS:	284 total (154 on HIA, 130 on VDT), 183 total human (101 on HIA, 82 on VDT), 131 total analyzed.
ANALYSIS TECHNIQUE(S)	Wilcoxon paired-replicate rank test
RESULTS/CONCLUSIONS:	Adding neg g strap to either restraint system was beneficial Effects included a decreased tendency toward submarining in -Gx impacts, better occupant-seat coupling during free falls, and improved +Gz impact protection. Additional analysis showed conventional restraint gave better impact protection (both -Gx and +Gz) than PCU-15/P
RAW DATA AVAILABILITY:	Magnetic tape, accessible by facility, title, test number; software for conversion to hard copy, photometric films by test number (Dyncorp, AAMRL/BBP, WPAFB)
TEST NUMBERS:	HIA1987-HIA2019, HIA2034-HIA2079, HIA2089-HIA2163; VDT596-VDT725
REMARKS, DEFINITIONS:	1 AAMRL/BBP coordinate system (Left-Hand Rule) for acceleration direction definitions. 2 Origin of seat coordinate system is midpoint of seat back-seat pan intersection. 3 MAX VELOCITY is the maximum velocity, occurring at impact, for vertical deceleration tests, and the maximum velocity as a result of impact for horizontal acceleration tests. 4 The HEAD and CHEST SEVERITY INDICES (File2 records) are injury prediction standards used by the Society of Automotive Engineers (Tenth Stapp Car Crash Conference, 1966) 5 START TIME (F4E531) is defined as time (msec) at which sled acceleration reached 0.5 G and remained at least 0 5 G for 5 msec (-Gx tests), or as time at which the minimum carriage velocity occurred (+Gz tests) 6 All times (including TIME MAX VEL, F2E41) are referenced to the start of the data file 7 EVENT DURATION (File 2 and File 4 records), available for HIA tests only, is uncorrected, from original analog data. 8 REFERENCE MARK (F4E530), in msec, is the start of the event processing window It represents a voltage pulse on the electronic data tape (where time 0 is the start of the data file)

corresponding to a flash on the film and is used to synchronize electronic and photometric data
9 For -Gx tests HIA2052-HIA2163, both side and corner onboard cameras, fiducial #10 (sled frame center) was tracked for one frame only.
10. When wrong coordinates were entered during photometric data processing (noted in F4E006 of appropriate File 4 records), the reformatted tape file has corrected coordinates, the original tape file does not

FIELD DESCRIP FILE 2

F2E01 TEST NUMBER
F2E02: TEST CELL
F2E03 SUBJECT TYPE
F2E04 SUBJECT ID
F2E05. PEAK ACCEL DIRECTION
F2E06 NOTES
F2E07· NEG G STRAP?
F2E21: PARENT ACCN NO
F2E22 TEST DATE
F2E31: SUBJECT AGE, YR
F2E32. SUBJECT WT, LB
F2E33. SUBJECT HT, IN
F2E34 SUBJ SITTG HT, IN
F2E35: PRELD,RESLTNT,LLAP, LB
F2E36: PRELD,RESLTNT,RLAP, LB
F2E37: PRELD,RESLTNT,SHDR, LB
F2E38 PRELD,RESLTNT,G STRAP, LB
F2E39 PEAK ACCEL, G
F2E40. MAX VELOCITY, FPS
F2E41: TIME MAX VEL, mS
F2E42 EVENT DURATION, mS
F2E54: CHEST SEVERITY INDEX
F2E55: HEAD SEVERITY INDEX

FIELD DESCRIP FILE 3·

VDT tests
F3E1: Test number
F3E2: Parent Accession number

F3E3(r,s,t) where r is
1= carriage acceleration, G
2= seat acceleration, G
3= chest acceleration, G
4= head acceleration, G
5= shoulder strap load, lb
6= left lap load, lb
7= right lap load, lb
8= total lap load, lb (vector sums, resultant)
9= seat link load, left, lb (s=1 only)
10= seat link load, right, lb (s=1 only)
11= seat link load, sum, lb (s=1 only)
12= seat link load, center, lb (s=2 only)
13= seat load, left, lb (s=3 only)
14= seat load, right, lb (s=3 only)
15= seat load, center, lb (s=3 only)
16= seat load, sum, lb (s=3 only)
17= negative g strap load, lb (use s=4)

s is
1= x-axis
2= y-axis
3= z-axis
4= resultant (for r=3-8), z-axis smoothed (for r=1-2)

and t is

1= impact maximum
2= time of impact maximum, msec
3= impact minimum
4= time of impact minimum, msec
5= freefall maximum (for r=5-17 only)
6= time of freefall maximum, msec (for r=5-17 only)

HIA tests
F3E1: Test number
F3E2 Parent Accession number

F3E3(r,s,t) where r is
1= sled acceleration, G
2= seat acceleration, G
3= chest acceleration, G
4= head acceleration, G
5= shoulder strap load, lb
6= left lap load, lb
7= right lap load, lb
8= total lap load, lb (vector sums, resultant)
9= seat link load, center, lb (s=2 only)
10= seat load, left, lb (s=3 only)
11= seat load, right, lb (s=3 only)
12= seat load, center, lb (s=3 only)
13= seat load, sum, lb (s=3 only)
14= negative g strap load, lb (use s=4)

s is
1= x-axis
2= y-axis
3= z-axis
4= resultant (for r=3-8, x-axis smoothed for r=1-2)

and t is
1= impact maximum
2= time of impact maximum, msec
3= impact minimum
4= time of impact minimum, msec
5= preimpact average (for r=5-13 only)

Item 2

FILE NUMBER:	001
ACCESSION NUMBER:	531
DATE OF LAST UPDATE.	88/08/12
EXTENSION (T5) ACCN NO	2415
PE/PROJ/TASK/WU	62202F-7231-1602
TITLE:	Evaluation of the Influence of Upper Extremity Bracing Techniques on Human Response During Vertical Impact
INVESTIGATORS:	Bernard F. Hearon, James W. Brinkley, James H. Raddin, Jr., Lawrence A McGowan, Joseph M Powers
TESTING START	801126
TESTING END:	801217
CURRENT CONTACT:	James W. Brinkley
CONTACT ADDRESS:	AAMRL/BBP, WPAFB Ohio 45433
CONTACT PHONE.	(513)255-3931, Autovon 785-3931
TECH REPORT NO	AFAMRL-TR-82-54, see also AFAMRL-TR-82-74
PROTOCOL NO	80-01 (Generic Protocol), 80-40, 80-37 (for G cell tests)

KEY WORDS:	Biomechanical Protection, Crew Restraint, Vertebral Fractures, Acceleration, F-111, Volunteer Subjects, Dummy or Manikin
OBJECTIVE(S):	Evaluate effectiveness of upper extremity bracing techniques during +Gz (vertical) impact acceleration by measuring differences in impact responses of volunteer subjects as a function of the bracing technique, and to correlate subject anthropometry with ability to comply with the crossed-arms bracing technique (K cell tests)
TEST MATRIX	G: Hands relaxed in lap (no bracing) K: Crossed-arms bracing L: Hands-on-knees bracing
MATRIX ELEMENT RANGES:	+Gz peak at 10.5 G mean (s d =0 23), 26 fps
MEASURED VARIABLES	Restraint harness geometry (strap angles), restraint harness static preloads, restraint harness loads during impact, forces reacted at seat, footrest, triaxial translational acceleration components at seat, head, chest, displacements of photometric targets located at facemask (crossed-arms and hands-on-knees positions) or mouth pack (hands-in-lap position), cheek (hands-on-knees and hands-in-lap positions), left glove (crossed-arms position), lower helmet, upper helmet, shoulder, elbow (both elbows in crossed-arms position) (all right side), chest, and five targets distributed on fixture (only one target on fixture in crossed-arms position)
FACILIT(IES)/LAB(S):	Vertical Deceleration Tower (VDT), AAMRL/BBP, WPAFB
INSTRUMENTATION.	Piezoresistive accelerometers, triaxial strain gauge load cells, triaxial translational accelerometer arrays, tachometer; strain gauge load links; automotive belt load cells, ADACS (Automatic Data Acquisition and Control System), DEC PDP 11/34 computer (for data processing), high-speed 16 mm cameras, Automatic Film Reader system, DGC Nova 3/12 computer (for photometric data acquisition).
INCIDENTAL EQUIPMENT	Appropriate size flight helmet, oxygen mask, flight gloves (mask and gloves not used for G cell), cut-off long underwear, athletic supporters for male subjects, bathing suit for female subject, disposable dental bite blocks (for mounting accelerometer array), EKG electrodes, telemetry and recorder; Instant Analytical Replay (INSTAR) video system
TOTAL NO OF TESTS:	55 total, 48 human, 47 analyzed
ANALYSIS TECHNIQUE(S):	Wilcoxon paired-replicate rank test.
RESULTS/CONCLUSIONS	In general, 1 With the HANDS-ON-KNEES bracing position, a greater proportion of the load is carried through the extremities to the footrest (and lap belt), with less vertebral column loading, than with the HANDS-IN-LAP or CROSSED-ARMS bracing position 2. The torso seems equally well stabilized in the two bracing positions. 3 Six of the eighteen subjects (33%) were unable to perform the crossed-arms brace Compliance did not seem to be directly correlated with arm length It did seem to be correlated with, though not uniquely predictable on the basis of, a "Body Habitus Index" (sum of neck, chest and flexed bicep circumferences) Compliance did not seem to be correlated with other relevant anthropometric measurements

4 The investigators recommend abandonment of the crossed-arms bracing technique and adoption of the hands-on-knees position for F-111 ejectees

More specifically,

1 In the comparison between HANDS-IN-LAP and CROSSED-ARMS (G K), the CROSSED-ARMS bracing showed significant increases in carriage velocity, seat acceleration and shoulder-strap loads; but the HANDS-IN-LAP tests showed significant increases in chest acceleration (-x-axis), Chest Severity Index, head acceleration (+x, +z-axes and resultant), Head Severity Index, crotch strap load and footrest loads (-x, +z-axes, resultant)

2. In the comparison between HANDS-IN-LAP and HANDS-ON-KNEES (G L), the HANDS-ON-KNEES bracing showed increases in carriage velocity, seat acceleration, total lap belt load and footrest loads (-x-axis and resultant), but the HANDS-IN-LAP tests showed increases in chest acceleration (+x, +z-axes, resultant), Chest Severity Index, head acceleration (+x-axis), Head Severity Index, shoulder strap loads and seat pan loads (-x, +z-axes, resultant).

3. In the comparison between the bracing positions, HANDS-ON-KNEES or CROSSED-ARMS (L K), the CROSSED-ARMS tests showed increases in shoulder strap loads and seat pan loads (+z-axis, resultant), but the HANDS-ON-KNEES bracing showed increases in head acceleration (+z-axis, resultant), head severity index, total lap belt load, crotch strap load and footrest loads (-x, +z-axes and resultant)

RAW DATA AVAILABILITY: Magnetic tape, accessible by facility, title, test number; software for conversion to hard copy; photometric films by test number. (Dyncorp, AAMRL/BBP, WPAFB).

TEST NUMBERS: VDT301, VDT529-VDT564, VDT456, VDT458-VDT461, VDT463-VDT469, VDT492, VDT516, VDT520, VDT524, VDT526, VDT527.

REMARKS, DEFINITIONS:

1. The F-111 operational harness used in all tests has a negative g (crotch) strap
2 AAMRL/BBP coordinate system (Left-Hand Rule) for acceleration direction definitions
3 G cell tests were part of a previous study
4. Inertia reel replaced by simple webbing clamp bar at reel centerline
5 The AVG REEL STR ANGLE given in TSTINDX and TSTLOG records s the average of the right and left shoulder (reel strap) values which sometimes differed by 1-3 degrees
6 MAX VELOCITY is the maximum velocity, occurring at impact, for vertical deceleration tests.
7. All times (including TIME MAX VEL, F2E41) are referenced to the start of the data file
8. The CHEST and HEAD SEVERITY INDICES and HEAD INJURY CRITERIA are injury prediction standards used by the Society of Automotive Engineers (Tenth Stapp Car Crash Conference, 1966)

FIELD DESCRIP FILE 2:

F2E01: TEST NUMBER
F2E02 TEST CELL
F2E03 SUBJECT TYPE
F2E04 SUBJECT ID
F2E05 PEAK ACCEL DIRECTION
F2E06 NOTES
F2E21: PARENT ACCN NO
F2E22 TEST DATE
F2E31 SUBJECT AGE, YR

F2E32 SUBJECT WT, LB
F2E33 SUBJECT HT, IN
F2E34 SUBJ SITTG HT, IN
F2E35 PRELD,RESLTNT,LLAP, LB
F2E36 PRELD,RESLTNT,RLAP, LB
F2E37 PRELD,RESLTNT,LSHR, LB
F2E38 PRELD,RESLTNT,RSHR, LB
F2E39 PEAK ACCEL, G
F2E40 MAX VELOCITY, FPS
F2E41 TIME MAX VEL, mS
F2E52 SEAT ELEV, IN
F2E53 AVG REEL STRAP ANGLE, DEG
F2E54 CHEST SEVERITY INDEX
F2E55 HEAD SEVERITY INDEX
F2E56 HEAD INJURY CRITERIA

FIELD DESCRIP FILE 3

F3E1: Test number
F3E2. Parent Accession number

F3E3 (r,s,t) where r is
1= carriage acceleration, G
2= seat acceleration, G
3= chest acceleration, G
4= head acceleration, G
5= total shoulder strap load, lb (s=4 only)
6= left lap load, lb (s=4 only)
7= right lap load, lb (s=4 only)
8= total lap load, lb (s=4 only)
9= seat link load, left, lb (s=1 only)
10= seat link load, right, lb (s=1 only)
11= seat link load, sum, lb (s=1 only)
12= seat link load, center, lb (s=2 only)
13= seat load, left, lb (s=3 only)
14= seat load, right, lb (s=3 only)
15= seat load, center, lb (s=3 only)
16= seat load, sum, lb (s=3 only)
17= negative g strap load, lb (use s=4)
18= resultant seat force, lb (use s=4)
19= foot load, left, lb (s=1,2,3)
20= foot load, right, lb (s=1,2,3)
21= foot load, center, lb (s=1,2,3)
22= foot load, sum, lb (use s=4)
23= shoulder load, reflection strap, left, lb (use s=4)
24= shoulder load, reel strap, left, lb (use s=4)
25= shoulder load, total, left, lb (use s=4)
26= shoulder load, reflection strap, right, lb (use s=4)
27= shoulder load, reel strap, right, lb (use s=4)
28= shoulder load, total, right, lb (use s=4)
29= shoulder load, total reflection strap, lb (use s=4)
30= shoulder load, total reel strap, lb (use s=4)
31= seat acceleration #2, G (s=3 only)
32= foot plate acceleration, G (s=3 only)

s is
1= x-axis
2= y-axis
3= z-axis
4= resultant (for r=3-7), z-axis smoothed (for r=1-2)

and t is
1= impact maximum
2= time of impact maximum, msec
3= impact minimum
4= time of impact minimum, msec

2.6.2. Test Index Records

These records were displayed by invoking a run module which uses data in the parent record as labels for the Test Index data. They are children of the parent records displayed in Section 2 6.1.

ITEM 1

FILE NUMBER	002
ACCESSION NUMBER·	202
DATE OF LAST UPDATE:	88/08/15
TEST NUMBER	HIA2162
TEST CELL	B
SUBJECT TYPE	Human-M
SUBJECT ID	J-3
PEAK ACCEL DIRECTION	-Gx
NEG G STRAP?·	Yes
PARENT ACCN NO	1
TEST DATE:	820319
SUBJECT AGE, YR	27
SUBJECT WT, LB	166
SUBJECT HT, IN	70.4
SUBJ SITTG HT, IN:	36 1
PRELD,RESLTNT,LLAP, LB	21
PRELD,RESLTNT,RLAP, LB·	19
PRELD,RESLTNT,SHDR, LB	24
PRELD,RESLTNT,G STRAP, LB·	6
PEAK ACCEL, G·	9.61
MAX VELOCITY, FPS.	30 16
TIME MAX VEL, mS·	417
EVENT DURATION, mS	148
CHEST SEVERITY INDEX:	48 08
HEAD SEVERITY INDEX:	37 50

ITEM 2

FILE NUMBER:	002
ACCESSION NUMBER	251
DATE OF LAST UPDATE.	88/08/15
TEST NUMBER:	VDT686
TEST CELL	H
SUBJECT TYPE.	Human-M
SUBJECT ID:	C-1
PEAK ACCEL DIRECTION	+Gz
NEG G STRAP?	Yes
PARENT ACCN NO	1
TEST DATE.	820526
SUBJECT AGE, YR	26
SUBJECT WT, LB	172
SUBJECT HT, IN:	69 8
SUBJ SITTG HT, IN	37 6
PRELD,RESLTNT,LLAP, LB	25
PRELD,RESLTNT,RLAP, LB:	19
PRELD,RESLTNT,SHDR, LB	20
PRELD,RESLTNT,G STRAP, LB·	24
PEAK ACCEL, G	10 69
MAX VELOCITY, FPS	26.25
TIME MAX VEL, mS.	1367
CHEST SEVERITY INDEX	27 89
HEAD SEVERITY INDEX	20 22

ITEM 3

FILE NUMBER	002
ACCESSION NUMBER	565
DATE OF LAST UPDATE	86/03/17
TEST NUMBER	VDT562
TEST CELL:	L
SUBJECT TYPE:	Human-M
SUBJECT ID	F-2
PEAK ACCEL DIRECTION	+Gz
NOTES	Front camera lights failed, bad circuit breaker
PARENT ACCN NO·	531
TEST DATE	801217
SUBJECT AGE, YR·	25
SUBJECT WT, LB	154
SUBJECT HT, IN	67 1
SUBJ SITTG HT, IN	37 4
PRELD,RESLTNT,LLAP, LB	18
PRELD,RESLTNT,RLAP, LB	25
PRELD,RESLTNT,LSHR, LB	10
PRELD,RESLTNT,RSHR, LB	18
PEAK ACCEL, G	11 64
MAX VELOCITY, FPS	26 27
TIME MAX VEL, mS	3792
SEAT ELEV, IN	0
AVG REEL STRAP ANGLE, DEG	5
CHEST SEVERITY INDEX	36 45
HEAD SEVERITY INDEX	20 82
HEAD INJURY CRITERIA·	16 43

ITEM 4

FILE NUMBEk	002
ACCESSION NUMBER	566
DATE OF LAST UPDATE:	86/03/17
TEST NUMBER·	VDT5o3
TEST CELL.	K
SUBJECT TYPE:	Human-F
SUBJECT ID	G-2
PEAK ACCEL DIRECTION	+Gz
PARENT ACCN NO	531
TEST DATE.	801217
SUBJECT AGE, YR:	24
SUBJECT WT, LB	117
SUBJECT HT, IN	62 9
SUBJ SITTG HT, IN.	33 3
PRELD,RESLTNT,LLAP, LB	21
PRELD,RESLTNT,RLAP, LB	30
PRELD,RESLTNT,LSHR, LB	13
PRELD,RESLTNT,RSHR, LB	9
PEAK ACCEL, G	11 14
MAX VELOCITY, FPS	26 19
TIME MAX VEL, mS	3851
SEAT ELEV, IN	2
AVG REEL STRAP ANGLE, DEG	6 75
CHEST SEVERITY INDEX	20 60
HEAD SEVERITY INDEX	16 69
HEAD INJURY CRITERIA	13 72

2.6.3. Test Data Records

Test Data records are normally displayed in table form by selecting a document set of records which have the desired characteristics according to the choices shown in the parent record(s) and then using the BASIS REPORT DISPLAY directive to generate a table showing only the subfields desired.

Viewed with the ordinary BASIS DISPLAY rather than the REPORT (i.e., table) format, the record would be displayed as a solid "block" of numbers separated by the array delimiters, not a very useful display. The "user" in the following example asked BASIS to display, in report format, the fields F3E1, F3E3(1,1,1), F3E3(3,4,1), F3E3(4,4,1), F3E3(8,4,1), and F3E2; which represent the variables test number, sled acceleration x-axis maximum, chest acceleration resultant maximum, head acceleration resultant maximum, lap load resultant maximum, and the parent (Study) accession number, respectively. (See the Study record samples in Section 2.6.1.)

Note that the data in this file is closest to raw data, and that the terms "minimum" and "maximum" applied to accelerations must be interpreted with consideration for directional signs, that is, with regard to whether the impact is -Gx, +Gz, etc.

TEST	Sl X Max,G	Ch Res Max,G	Hd Res Max, G	Lap Res Max, Lb	STUDY
HIA2162	0.61	20 95	11 62	1775 16	1
VDT686	2.87	15 04	11 99	297 44	1
VDT562	1.42	18 93	13 61	100.53	531
VDT563	1 51	16 06	11 23	55.21	531

2.6.4. Test Log Records

These Test Log records are children of the parent records shown in Section 2.6.1. The items which represent Common Test Log records can be identified by the special "test number"-- the facility acronym is followed directly by triple X's and a dash followed by the parent accession number (which also appears in the next field, as usual). This section simulates the display which would result from invoking a run module analogous to the one that exists for Test Index records. (The run module for Test Log records is partly written, but not yet in operation.)

Item 1

FILE NUMBER:	004
ACCESSION NUMBER	1664
DATE OF LAST UPDATE:	87/12/17
TEST NUMBER.	VDTXXX-1
PARENT ACCN NO	1
PLUNGER NO/METERING PIN:	102
RSTRNT ATTCHMT LOCTNS	(Exact coordinates not available) Lap belts anchored at two points, shoulder straps at single location on aft bulkhead, negative g strap anchored 15 inches forward of seat reference axis, 3/5 inch below x-axis
OTHER PROTCTV GEAR:	USAF HGU-26/P flight helmets, athletic supporters for males
SEAT ASSMBLY DRWNG NO	80MRL-E-359-1,2
SEAT TYPE.	VIP

HEADREST POSITION	1 inch aft of seat back
WAVEFORM	Half Sine
SEAT BACK ANGLE, DEG-	90
H2O HT/SET VOL L, IN	0
ORIF DIAM/LOAD VOL L, IN	9 145
DC ONBD VMRAS, STATUS	On at -04 sec, Off at +04 sec
TIMING AUX INFO:	On at +00 sec, Off at +03 sec
FIDUCIAL LOCATIONS	1= Upper Carriage, 2= Upper Left Frame, 3= Center Carriage, 4= Center Right Frame, 5= Lower Left Frame, 6= Lower Right Frame, 7= Right Elbow, 8= Right Shoulder, 9= Chest Pack, 10= Mouth Pack, 11= Lower Right Helmet, 12= Upper Right Helmet
CAMERA1 LOC, DESCRIP-	Front Corner. Milliken DBM45, S/N 44699 2 (Tests VDT596-VDT700), S/N 4637 (Tests VDT701-VDT725), Lens 10 mm, Speed 500 frames/sec
CAMERA2 LOC, DESCRIP-	Side Milliken DBM45, S/N 4720, Lens 10 mm, Speed 500 frames/sec
LED DRIVR, DC FIXD CAMRA	Cameras 1,2 Ch 6, 5 mA
CHANNEL ASSMTS	1= Carriage/Sled Accel, x-axis, 2= Carriage/Sled Accel, y-axis, 3= Carriage/Sled Accel, z-axis, 4= Head Accel, x-axis, 5= Head Accel, y-axis, 6= Head Accel, z-axis, 7= Chest Accel, x-axis, 8= Chest Accel, y-axis, 9= Chest Accel, z-axis, 10= Left Seat Pan Load, 11= Right Seat Pan Load, 12= Center Seat Pan Load, 13= Left Load Link, x-axis, 14= Right Load Link, x-axis, 15= Left Lap Load, x-axis, 16= Left Lap Load, y-axis, 17= Left Lap Load, z-axis, 18= Right Lap Load x axis, 19= Right Lap Load, y-axis, 20= Right Lap Load, z-axis, 21= Shoulder Load, x-axis, 22= Shoulder Load, y-axis, 23= Shoulder Load, z-axis, 24= Seat Accel, x-axis, 25= Seat Accel, y axis, 26= Seat Accel, z-axis, 27= Center Load Link, y-axis, 29= Carriage Velocity,

30= Negative G Strap Load,
37= Event Marker,
46= 10 Volt Excitation,
47= 2 5 Volt Bias

TPANSDCR IDs , SENS, FS·

Ch 1= Endevco 2264-200, S/N BX49,
2 580 mV/G, 9 69 G FS,

2= Endevco 2264-150, S/N BB11,
2 374 mV/G, 10 53 G FS,

3= Endevco 2262A-200, S/N FR42,
4 129 mV/G, 24 22 G FS,

4= Endevco 2264-200, S/N BP10,
2 479 mV/G, 20 17 G FS;

5= Endevco 2264-200, S/N BQ42,
2 704 mV/G, 18 5 G FS,

6= Endevco 2264-200, S/N BQ51,
2 554 mV/G, 39 15 G FS,

7= Endevco 2264-150, S/N BC26,
2 795 mV/G, 17 89 G FS,

8= Endevco 2264-150, S/N BB13,
2 414 mV/G, 10 36 G FS,

9= Endevco 2264-150, S/N 2A20,
2 615 mV/G, 38 24 G FS,

10= Strainsert FL25U-2SKPT, S/N 3294-3,
8 164 uV/lb, 1523 lb FS,

11= Strainsert FL25U-2SKPT, S/N 3294-5,
8 193 uV/lb, 1518 lb FS,

12= Strainsert FL25U-2SKPT, S/N 3294-6,
8 065 uV/lb, 1542 lb FS,

13= Micro Measurements EA-06-062TJ-350, S/N 2,
10 2 uV/lb, 609 7 lb FS;

14= Micro Measurements EA-06-062TJ-350, S/N 3,
10 63 uV/lb, 585 0 lb FS,

15= GM 3D-SW, S/N 15X,
4 99 uV/lb, 1246 lb FS,

16= GM 3D-SW, S/N 15Y,
5 30 uV/lb, 590 lb FS,

17= GM 3D-SW, S/N 15Z,
6 14 uV/lb, 1013 lb FS;

18= GM 3D-SW, S/N 21X,
4 87 uV/lb, 1277 lb FS,

19= GM 3D-SW, S/N 21Y,
4 82 uV/lb, 648 lb FS,

20= GM 3D-SW, S/N 21Z,
5 96 uV/lb, 1043 lb FS,

21= GM 3D-SW, S/N 20Z,
6 22 uV/lb, 1000 lb FS,

22= GM 3D-SW, S/N 20Y,
5 37 uV/lb, 582 lb FS,

23= GM 3D SW, S/N 20X,
5 02 uV/lb, 1239 lb FS,

24= Endevco 2264-200, S/N BV95,
2 962 mV/G, 16 88 G FS,

25= Endevco 2264-200, S/N BV56,
2.749 mV/G, 18 19 G FS,

26= Endevco 2264-200, S/N BW71,
2 889 mV/G, 17 32 G FS,

27= Micro Measurements EA-062TJ-350, S/N 5,
9 79 uV/lb, 635 lb FS,

29= Globe 22A672, S/N 3,
0 5019 V/fps, 2.5 V=31 1 fps FS;

30= Strainsert FL1U-2SG, S/N 207,
19 81 uV/lb, 628 lb FS,

37= 2.5 V FS,

46= 2.5 V FS,

47= 2 5 V FS

TRANSDCR ZEROS, RANGES:	All channels except 29,46 Zero 2 5, Range +5 0 to -0 0, 29. 2 5, +2 5 to -0 0, 46: 5 0, +5 0 to -0 0
EXCITATION VOLTS:	All channels 10.00
FILTER IDs, SENS	All channels except 37,46,47 Series 60, S/N same as channel number, 120 Hz, 37 Series 1000, S/N 30, 2000 Hz, 46 Series 180, S/N 27, 360 Hz, 47 Series 180, S/N 14, 360 Hz.
SAMPLE RATES	All channels 1000/sec, Format 1
AMPLIFR IDs, GAINS	Ch 1= S/N 2, Gain 100, 2= S/N 16, Gain 100, 3= S/N 37, Gain 25; 4= S/N 3, Gain 50, 5= S/N 29, Gain 50, 6= S/N 10, Gain 25; 7= S/N 5, Gain 50, 8= S/N 19, Gain 100, 9= S/N 27, Gain 25, 10= S/N 3, Gain 201, 11= S/N 7, Gain 201, 12= S/N 8, Gain 201, 13= S/N 4, Gain 402, 14= S/N 9, Gain 402, 15= S/N 1, Gain 402, 16= S/N 1, Gain 800,

	17= S/N 3, Gain 402, 18= S/N 5, Gain 402, 19= S/N 2, Gain 800, 20= S/N 6, Gain 402, 21= S/N 7, Gain 402, 22= S/N 3, Gain 800, 23= S/N 10, Gain 402, 24= S/N 27, Gain 50, 25= S/N 21, Gain 100, 26= S/N 26, Gain 50, 27= S/N 2, Gain 402, 29= S/N 29, Gain 1, 30= S/N 11, Gain 201, 37= S/N 9, Gain 2 5, 46= Gain 1, 47= Gain 1
BRIDGE RESISTR INFO	Ch 1= Balance 200K, + into gnd, Complтn 1 6K, 2= Balance 120K, - into gnd, Compltn 1 6K; 4= Balance 680K, - into gnd, Compltn 1 65K, 5= Balance 114K, + into gnd, Compltn 1 65K, 6= Balance 250K, - into gnd, Compltn 1 65K, 7= Balance 1 2M, - into gnd, Compltn 1 65K; 8= Balance 305K, + into gnd, Compltn 1 65K, 9= Balance 155K, - into gnd, Compltn 1 65K, 14= Balance 26K, - into gnd, 15= Balance 60K, + into gnd, 16= Balance 16K, + into gnd, 17= Balance 28K, + into gnd, 18= Balance 13 5K, + into gnd, 19= Balance 11K, + into gnd, 20= Balance 90K, - into gnd; 21= Balance 48K, - into gnd, 22= Balance 800K, + into gnd, 23= Balance 77K, - into gnd, 24= Compltn 1 47K; 25= Balance 125K, - into gnd, Compltn 1 47K, 26= Balance 512K, - into gnd, Compltn 1 63K, 27= Balance 82K, + into gnd
NOTES, PROBLMS.	Ch 21 Use load cell z-axis calibration 29 Signal attenuated by 6 242 prior to signal conditioning Amplifier-negative output sensitivity = 0 5019/6 242 = 0 0804 V/fps 37 Event is negative pulse 46 Tests VDT596-VDT693 channel 46 divided by 2, test VDT694 and subsequent, divide by 4
COMPUTER ON, OFF	On at -06 sec, Off at +03 sec
FACILITY ON, OFF	On at +00 ms, Off at +01 ms
NO FRAMES PROCESSD	150
NO FRAMES FROM TBAR	0
EVENT FLASH STATUS	Yes
TBAR STATUS	Yes
PROGRAM NAMES:	RCVD (Command File), RCVD0A-RCVD0E, Reprocessed. RCLAP (Command File), RCLAP1-RCLAP3

Item 2

FILE NUMBER	004
ACCESSION NUMBER	1665

DATE OF LAST UPDATE.	87/12/21
TEST NUMBER	HIAXXX-1
PARENT ACCN NO·	1
PLUNGER NO/METERING PIN	2
RSTRNT ATTCHMT LOCTNS	(Exact coordinates not available) Lap belts anchored at two points, shoulder straps at single location on aft bulkhead, negative g strap anchored 15 inches forward of seat reference axis, 1/8 inch below x-axis
OTHER PROTCTV GEAR	Athletic supporters for males
SEAT ASSMBLY DRWNG NO	81MRL-4-106
SEAT TYPE.	40 G
HEADREST POSITION	1 inch aft of seat back
WAVEFORM	Half Sine
SEAT PAN INCLIN, DEG.	6
SEAT BACK ANGLE, DEG	13
H2O HT/SET VOL L, IN	54
ORIF DIAM/LOAD VOL L, IN	60
DC ONBD CMRAS, STATUS:	On at -03 sec, Off at +01 sec
TIMING AUX INFO	On at +00 sec, Off at +03 sec
FIDUCIAL LOCATIONS	1= Left Cheek; 2= Mouth Pack, 3= Left Shoulder, 4= Left Elbow, 5= Left Knee, 6= Aft Plexiglas, 7= Aft Seat Pan, 8= Lower Left Frame, 9= Number Plate, 10= Frame Center
CAMERA1 LOC, DESCRIP	Left Front Corner· Milliken DBM45, S/N 44699/2, Lens size varied (see variable records), Speed 500 frames/sec
CAMERA2 LOC, DESCRIP·	Left Side Milliken DBM45, S/N 4720; Lens 10 mm, Speed 500 frames/sec
LED DRIVR, AC FIXD CAMRA.	Camera 1 (Tests 2006-2060 only) -1 Override
LED DRIVR, DC FIXD CAMRA:	Cameras 1,2 3 0 mA, Fail
CHANNEL ASSMTS	1= Carriage/Sled Accel, x-axis, 2= Carriage/Sled Accel, y-axis, 3= Carriage/Sled Accel, z axis, 4= Head Accel, x-axis, 5= Head Accel, y-axis, 6= Head Accel, z-axis, 7= Chest Accel, x-axis; 8= Chest Accel, y-axis; 9= Chest Accel, z-axis, 10= Left Seat Pan Load; 11= Right Seat Pan Load, 12= Center Seat Pan Load, 13= Left Load Link, x-axis, 14= Right Load Link, x-axis;

15= Left Lap Load, x-axis,
16= Left Lap Load, y-axis,
17= Left Lap Load, z-axis,
18= Right Lap Load, x-axis,
19= Right Lap Load, y-axis,
20= Right Lap Load, z-axis,
21= Shoulder Load, x-axis,
22= Shoulder Load, y-axis,
23= Shoulder Load, z-axis,
24= Seat Accel, x-axis,
25= Seat Accel, y-axis,
26= Seat Accel, z-axis,
27= Center Load Link, y-axis,
29= Carriage Velocity,
30= Negative G Strap Load,
37= Event Marker,
47= 2.5 Volt Bias,
48= 10 Volt Excitation

TRANSDCR IDs, SENS, FS

Ch 1= Endevco 2262A-200, S/N FR42,
4.138 mV/G, 24.2 G FS;

2= Endevco 2264-200, S/N BW92,
2.385 mV/G, 21.0 G FS,

3= Endevco 2264-200, S/N BX48,
2.653 mV/G, 18.8 G FS,

4= Endevco 2264-200, S/N BP10,
2.469 mV/G, 40.5 G FS,

5= Endevco 2264-200, S/N BQ42,
2.689 mV/G, 18.6 G FS,

6= Endevco 2264-200, S/N BQ51,
2.536 mV/G, 39.4 G FS,

7= Endevco 2264-150, S/N BC26,
2.773 mV/G, 36.1 G FS,

8= Endevco 2264-150, S/N BB13,
2.404 mV/G, 20.8 G FS,

9= Endevco 2264-150, S/N 2A20,
2.600 mV/G, 38.5 G FS,

10= Strainsert FL25U-2SKPT, S/N 3294-3
8.164 uV/lb, 1523 lb FS,

11= Strainsert FL25U-2SKPT, S/N 3294-5,
8.193 uV/lb, 1518 lb FS,

12= Strainsert FL25U-2SKPT, S/N 3294-6,
8.065 uV/lb, 3100 lb FS,

13= Micro Measurements EA-06-062TJ-350, S/N 2,
10.32 uV/lb, 1205 lb FS,

14= Micro Measurements EA-06-062TJ-350, S/N 3,
10.79 uV/lb, 1153 lb FS,

15= GM 3D SW, S/N 15X,
5.04 uV/lb, 2468 lb FS,

16= GM 3D-SW, S/N 15Y,
5 03 uV/lb, 1173 lb FS,

17= GM 3D-SW, S/N 15Z,
6 24 uV/lb, 1993 lb FS;

18= GM 3D-SW, S/N 21X,
4 95 uV/lb, 2513 lb FS,

19= GM 3D-SW, S/N 21Y,
4 90 uV/lb, 1269 lb FS,

20= GM 3D-SW, S/N 21Z,
6 06 uV/lb, 2052 lb FS,

21= GM 3D-SW, S/N 20Z,
6 29 uV/lb, 1977 lb FS,

22= GM 3D-SW, S/\
5 46 uV/lb, 1139 lb FS,

23= GM 3D-SW, S/N 20X,
5 11 uV/lb, 2434 lb FS,

24= Endevco 2264-200, S/N BV95,
2 967 mV/G, 16 9 G FS,

25= Endevco 2264-200, S/N BV56,
2 743 mV/G, 18 2 G FS,

26= Endevco 2264-200, S/N BW71,
2 874 mV/G, 17 4 G FS,

27= Micro Measurements EA-06-062TJ-350, S/N 5,
9 98 uV/lb, 623 lb FS,

29= Globe 22A672, S/N 2,
0 2664 V/fps, 117 2 fps,

30= (Test HIA2036-HIA2054) Micro Measurements Strain Gage 20,
S/N 25 12 uV/lb, 495 lb FS,
30= (Test HIA1937-HIA2035, HIA2055-HIA2136)
Strainsert FL1U-2SG, S/N 2^07, 19 81 uV/lb 628 lb FS;

37= 2.5 V FS,

47= 2.5 V FS,

48= 5 0 V FS

TRANSDCR ZEROS, RANGES	All channels except 29,48 Zero 2 5, Range +5 0 to -0 0, 29 0 0, +5 0 to -0 0, 48 5 0, +5 0 to -0 0
EXCITATION VOLTS	All channels 10 00
FILTER IDs, SENS	All channels except 37,47,48 Series 60, S/N same as channel number, 120 Hz, 37 Series 1000, S/N 30, 2000 Hz, 47 Series 180, S/N 14, 360 Hz 48 Series 180, S/N 27, 360 Hz.
SAMPLE RATES	All channels 1000/sec, Format 1

AMPLIFR IDs, GAINS	Ch 1= S/N 10, Gain 25, 2= S/N 5, Gain 50, 3= S/N 26, Gain 50, 4= S/N 27, Gain 25, 5= S/N 3, Gain 50, 6= S/N 22, Gain 25; 7= S/N 20, Gain 25, 8= S/N 16, Gain 50, 9= S/N 37, Gain 25, 10= S/N 6, Gain 201, 11= S/N 7, Gain 201, 12= S/N 25, Gain 100, 13= S/N 3, Gain 201, 14= S/N 5, Gain 201; 15= S/N 8, Gain 201; 16= S/N 4, Gain 402; 17= S/N 1, Gain 201; 18= S/N 10, Gain 201, 19= S/N 9, Gain 402, 20= S/N 9, Gain 201; 21= S/N 4, Gain 201; 22= S/N 13, Gain 402, 23= S/N 11, Gain 201; 24= S/N 27, Gain 50, 25= S/N 14, Gain 50, 26= S/N 20, Gain 50; 27= S/N 5, Gain 402; 29= Gain 1, 30= S/N 12, Gain 201, 37= S/N 9, Gain 2 5, 47= Gain 1; 48= Gain 1
BRIDGE RESISTR INFO:	Ch 1= Balance 375K, - into gnd, 2= Balance 100K, - into gnd, Compltn 1.63K, 3= Balance 254K, - into V10, Compltn 1 63K, 4= Balance 680K, - into gnd, Compltn 1 65K, 5= Balance 114K, + into gnd, Compltn 1 65K, 6= Balance 250K, - into gnd, Compltn 1 65K, 7= Balance 1 2M, - into gnd, Compltn 1 65K, 8= Balance 305K, + into gnd, Compltn 1 65K; 9= Balance 155K, - into gnd, Compltn 1 65K; 14= Balance 26K, - into gnd, 15= Balance 40K, + into gnd; 16= Balance 13.7K, + into gnd, 17= Balance 15K, + into gnd, 18= Balance 13 5K, + into gnd; 19= Balance 12K, + into gnd, 20= Balance 90K, - into gnd, 22= Balance 800K, + into gnd, 23= Balance 160K, + into gnd, 24= Compltn 1 47K, 25= Balance 125K, - into gnd, Compltn 1.47K, 26= Balance 512K, - into gnd, Compltn 1 63K, 27= Balance 82K, + into gnd
NOTES, PROBLMS	Ch 21 Use load cell z-axis calibration 23: Use load cell x-axis calibration 29. 6 242 Attenuator located in signal conditioner Sens/Atten = 0 04268 V/fps Positive output. 37: Event is negative going
COMPUTER ON, OFF-	On at -06 sec, Off at +04 sec

FACILITY ON, OFF	On at +00 ms, Off at +01 ms
NO FRAMES FR TBAR	0
EVENT FLASH STATUS	Yes
TBAR STATUS	Yes
PROGRAM NAMES:	RCHA (Command File), RCHA0A-RCHA0E; Reprocessed: RCIMP (Command File), RCIMP1-RCIMP3

Item 3

FILE NUMBER	004
ACCESSION NUMBER	1757
DATE OF LAST UPDATE.	87/12/24
TEST NUMBER:	VDT686
PARENT ACCN NO	1
RESTRAINT TYPE.	Standard USAF, HBU configuration lap belt and shoulder harness Lap 1.75 inch wide Type XIII nylon (MIL-W-4088H), shoulder 1 75 inch wide Type I polyester (MB-6), negative g USAF P/N 45402-0101649-01, 1.75 inch wide Type I polyester, 10 inches long.
PEAK ACCEL, G·	10.69
OBJCTV PEAK G	10.00
OBJCTV IMPCT VEL, FPS	26
DROP HT/SLED TRAVL, FT	11.00
PHOTO TAPE, FILE NOS:	Side Camera: Tape 3, File 17, Corner Camera. Tape 3, File 19
NO FRAMES FR EVENT	Side Camera: 11; Corner Camera: 12
REFERENCE MARK, mS·	1244
TIME IMPACT START, mS·	1367

Item 4

FILE NUMBER	004
ACCESSION NUMBER	1974
DATE OF LAST UPDATE.	87/12/24
TEST NUMBER.	HIA2162
PARENT ACCN NO:	1
NOTES:	Corner Camera. Fiducial 4 out of picture approximately 150 frames.
RESTRAINT TYPE.	PCU-15/P (or PCU-16/P for smaller subjects and female subjects), HBU configuration lap belt. Lap 1.75 inch wide Type III polyester (MIL-W-25361), shoulder 1.75 inch wide Type I polyester (MIL-W-25361), negative g USAF P/N 45402-0101649-01, 1 75 inch wide Type I polyester, 10 inches long
EVENT DURATION, mS	148
PEAK ACCEL, G.	9 61
OBJCTV PEAK G:	10 00
OBJCTV IMPCT VEL, FPS	30
DROP HT/SLED TRAVL, FT	58 33
SET PRESSURE, PSIG:	30
LOAD PRESSURE, PSIG·	173
TRIGR PRESSURE, PSIG:	100
RAM DISPLCMNT	27 0
CAMERA1 LENS SIZE, mm:	13
PHOTO TAPE, FILE NOS:	Side Camera: Tape 18, File 55 Corner Camera: Tape 18, File 56

NO FRAMES PROCESSD·	Side and Corner Cameras 175
NO FRAMES FR EVENT	Side and Corner Cameras 11
REFERENCE MARK, mS	174
TIME IMPACT START, mS:	239

Item 5

FILE NUMBER	004
ACCESSION NUMBER	2409
DATE OF LAST UPDATE.	87/12/14
TEST NUMBER	VDT562
PARENT ACCN NO	531
PEAK ACCEL, G	11 64
AVG REEL STRP ANGLE, DEG	5
SEAT HT, IN	0
PHOTO TAPE, FILE NOS	Tape 11, File 21

Item 6

FILE NUMBER	004
ACCESSION NUMBER	2410
DATE OF LAST UPDATE	87/12/14
TEST NUMBER:	VDT563
PARENT ACCN NO:	531
PEAK ACCEL, G	11 14
AVG REEL STRP ANGLE, DEG	6.75
SEAT HT, IN	2
PHOTO TAPE, FILE NOS	Tape 11, File 23

Item 7

FILE NUMBER	004
ACCESSION NUMBER:	2414
DATE OF LAST UPDATE:	87/12/17
TEST NUMBER.	VDTXXX-531
PARENT ACCN NO:	531
PLUNGER NO:	102
RESTRAINT TYPE.	F/FB-111: Lap, negative g, and chest 1.75 inch Terylene webbing, shoulder 1 75 inch Type I polyester (MIL-W-25361)
RSTRNT ATTCHMT LOCTNS:	Reflection straps attached to upper portion of seat back 24 09 inches above seat reference axis, (attachment points move vertically as seat is moved up or down), inertia reel attachment points (on waterline 200 75) fixed at 27 5 inches above lowest position of seat reference axis, (inertia reel strap angle varies with vertical seat adjustment).
OTHER PROTCTV GEAR	USAF HGU-26/P flight helmets, MBU-5/P oxygen masks, Nomex flight gloves, athletic supporters for males
SEAT ASSMBLY DRWNG NO·	GD/FW 12FTJ22969
SEAT TYPE.	F/FB-111
HEADREST POSITION	2 25 inches forward of seat back
WAVEFORM:	Sawtooth
OBJCTV PEAK G:	10
OBJCTV IMPCT VEL, FPS	26
SEAT BACK ANGLE, DEG	90
DROP HT, FT:	11

H2O HT, IN	0
ORIF DIAM, IN	9 145
FIDUCIAL LOCATIONS	1= Facemask, 2= K Cell Left Glove, L Cell Right Cheek, 3= Lower Right Helmet, 4= Upper Right Helmet, 5= Right Shoulder, 6= Right Elbow, 7= K Cell Left Elbow, L Cell Upper Right Frame, 8= K Cell Upper Right Frame, L Cell Front Head Rest, 9= L Cell Rear Head Rest, 10= L Cell. Upper Seat Back, 11= L Cell Lower Seat Back, 12= L Cell Chest Pack
CAMERA1 LOC, DESCRIP:	Front Milliken DBM45, Lens 16 mm, focal length 10 mm· Speed 500 frames/sec
CAMERA 2 LOC, DESCRIP.	Right Side Milliken DBM45, Lens 16 mm, focal length 10 mm, Speed 500 frames/sec
CHANNEL ASSMTS	1= Carriage Accel, z-axis; 2= Head Accel, x-axis, 3= Head Accel, y-axis, 4= Head Accel, z-axis, 5= Chest Accel, x-axis, 6= Chest Accel, y-axis, 7= Chest Accel, z-axis, 8= Left Lap Load, 9= Right Lap Load, 10= Negative G Strap Load, 11= Left Seat Pan Load, 12= Right Seat Pan Load, 13= Center Seat Pan Load, 14= Left Reflection Strap Load, 15= Right Reflection Strap Load, 16= Left Inertia Reel Strap Load, 17= Right Inertia Reel Strap Load, 18= Left Load Link, x-axis, 19= Right Load Link, x-axis, 20= Left Foot Load, x-axis, 21= Left Foot Load, y-axis, 22= Left Foot Load, z-axis; 23= Right Foot Load, x-axis; 24= Right Foot Load, y-axis, 25= Right Foot Load, z-axis, 26= Center Foot Load, x-axis, 27= Center Foot Load, y-axis, 28= Center Foot Load, z-axis, 29= Velocity, 31= Carriage Accel, y-axis, 32= Seat Accel, x-axis; 33= Seat Accel, y-axis, 34= Seat Accel, z-axis, 35= Center Load Link, y-axis, 36= Carriage Accel, x-axis, 38= Seat Pan, z2, 39= Foot Plate, z-axis, 47= 2 5 Volt Bias, 48= 10 Volt Excitation
TRANSDCR IDs, SENS, FS	Ch 1= Endevco 2262A-200, S/N FR42,

4 161 mV/G, 24 03 G FS,

2= Endevco 2264-200, S/N BP10,
2 496 mV/G, 20 03 G FS,

3= Endevco 2264-200, S/N BQ42,
2 713 mV/G, 9 21 G FS,

4= Endevco 2264-200, S/N BQ51,
2 553 mV/G, 39 17 G FS,

5= Endevco 2264-150, S/N BC26,
2 786 mV/G, 17 95 G FS,

6= Endevco 2264-150, S/N BB13,
2 430 mV/G, 10 29 G FS,

7= Endevco 2264-150, S/N 2A20,
2 619 mV/G, 38 18 G FS,

8= Micro Measurements EA-06-125-BZ-350, S/N 13,
15 10 uV/lb, 824 lb FS,

9= Micro Measurements EA-06-125-BZ-350, S/N 14,
13 66 uV/lb, 911 lb FS;

10= Micro Measurements EA-06-125-BZ-350, S/N 143377,
1 80 uV/lb, 1736 lb FS,

11= Strainsert FLU25-2SPKT, S/N 3294-5,
8 040 uV/lb, 1547 lb FS,

12= Strainsert FLU25-2SKPT, S/N 3294-4,
7.988 uV/lb, 1557 lb FS;

13= Strainsert FLU25-2SKPT, S/N 3294-6,
8 011 uV/lb, 1553 lb FS;

14= Micro Measurements EA-06-125-BZ-350, S/N 02-10,
26 32 uV/lb, 950 lb FS,

15= Micro Measurements EA-06-125-BZ-350, S/N 01-3,
34 04 uV/lb, 734 lb FS,

16= Lebow 3419-35K, S/N 363,
7 86 uV/lb, 791 lb FS,

17= Lebow 3419-35K, S/N 364,
7 54 uV/lb, 825 lb FS,

18= Micro Measurements EA-06-062-TJ-350, S/N 001,
10 79 uV/lb, 576 lb FS,

19= Micro Measurements EA-06-062-TJ-350, S/N 002,
10 11 uV/lb, 615 lb FS,

20= GSE T-10952C, S/N 001,
27 64 uV/lb, 904 lb FS,

21= GSE T-10952C, S/N 001,
28 61 uV/lb, 874 lb FS,

22= GSE T-10952C, S/N 001,
16 93 uV/lb, 2953 lb FS,

23= GSE T-10952C, S/N 002,
28 36 uV/lb, 882 lb FS,

24= GSE T-10952C, S/N 002,
28 16 uV/lb, 888 lb FS;

25= GSE T-10952C, S/N 002,
16 61 uV/lb, 3010 lb FS,

26= GSE T-10952C, S/N 003,
27 94 uV/lb, 895 lb FS,

27= GSE T-10952C, S/N 003,
28 08 uV/lb, 890 lb FS,

28= GSE T-10952C, S/N 003,
16 50 uV/lb, 3030 lb FS,

29= Globe 22A672, S/N 3,
0 5019 V/fps, 62 2 fps FS;

31= Endevco 2264-150, S/N BB11,
2 354 mV/G, 21.24 G FS,

32= Endevco 2264-200, S/N BV63,
2 564 mV/G, 19 50 G FS,

33= Endevco 2264-200, S/N BV41,
3 298 mV/G, 15 16 G FS;

34= Endevco 2264-200, S/N BN63,
2 825 mV/G, 17 70 G FS,

35= Micro Measurements EA-06-062-TJ-350, S/N 004,
10 23 uV/lb, 608 lb FS;

36= Endevco 2264-200, BX49,
2 581 mV/G, 19 37 G FS,

38= Entran EGA-125-100D, S/N A4-4,
1 679 mV/G, 29 78 G FS,

39= Entran EGA-125-100D, S/N A5-5,
1.617 mV/G, 30 92 G FS,

47= 2.5 V FS,

48= 5 V FS

TRANSDCR ZEROS, RANGES	All channels except 29,48 Zero 2.5, Range +5 0 to -0 0, 29. 5 0, +5 0 to -0 0, 48 0 0, +5 0 to -0 0
EXCITATION VOLTS	All channels 10 00
FILTER IDs, SENS	All channels except 38,39,47,48 Series 60, S/N same as channel number, 120 Hz; 38 Series 60, S/N 30, 120 Hz, 39 Series 60, S/N 37, 120 Hz, 47 Series 180, 360 Hz; 48 Series 180, 360 Hz
SAMPLE RATES	All channels 1000/sec, Format 1

AMPLIFR IDs, GAINS	Ch 1= S/N 37, Gain 25, 2= S/N 21, Gain 50, 3= S/N 17, Gain 100, 4= S/N 10, Gain 25, 5= S/N 26, Gain 50, 6= S/N 5, Gain 100, 7= S/N 7, Gain 25, 8= S/N 11, Gain 201, 9= S/N 9, Gain 201, 10= S/N 10, Gain 800, 11= S/N 7, Gain 201, 12= S/N 10, Gain 201, 13= S/N 3, Gain 201, 14= S/N 15, Gain 100, 15= S/N 21, Gain 200, 16= S/N 8, Gain 402, 17= S/N 4, Gain 402, 18= S/N 11, Gain 402, 19= S/N 13, Gain 402, 20= S/N 22, Gain 100, 21= S/N 24, Gain 100, 22= S/N 14, Gain 50, 23= S/N 6, Gain 100, 24= S/N 19, Gain 100, 25= S/N 19, Gain 50, 26= S/N 25, Gain 100, 27= S/N 16, Gain 100, 28= S/N 16, Gain 50, 29= Gain 1, 31= S/N 3, Gain 50, 32= S/N 27, Gain 50, 33= S/N 5, Gain 50, 34= S/N 32, Gain 50, 35= S/N 5, Gain 402, 36= S/N 28, Gain 50, 38= S/N 23, Gain 50, 39= S/N 30, Gain 50, 47= Gain 1; 48= Gain 1
BRIDGE RESISTR INFO.	Ch 2= Balance 680K, - into gnd, Complтn 1 65K, 3= Balance 114K, - into gnd, Compltn 1 65K, 4= Balance 250K, - into gnd, Compltn 1 65K, 5= Balance 1 2M, - into gnd, Compltn 1 65K, 6= Balance 220K, - into gnd, Compltn 1 65K; 7= Balance 155K - into gnd, Compltn 1 65K, 8= Balance 3 95K, - into gnd, 9= Balance 40K, - into gnd, 10= Balance 470K, into gnd, 15= Balance 20K, - into gnd, 18= Balance 106K, + into gnd, 19= Balance 55K, - into gnd, 31= Balance 1M, - into gnd, Compltn 1 65K; 32= Balance 397K, - into gnd, Compltn 1 47K; 33= Balance 125K, - into gnd, Compltn 1 47K, 34= Balance 514K, - into gnd, Compltn 1 63K, 35= Balance 82K, - into gnd, 36= Balance 127K, - into gnd, Compltn 1 47K
NOTES, PROBLMS	Ch 12 Use tension calibration sensitivity 29 Signal attenuated by 6 242 prior to signal conditioning Amplifier-negative output sensitivity = 0 5019/6 242 = 0 0804 V/fps

COMPUTER ON, OFF	On at 03 sec, Off at -01 sec
FACILITY ON, OFF	On at +00 ms, Off at +01 ms
NO FRAMES PROCESSD	150
NO FRAMES FR EVENT	11
NO FRAMES FR TBAR	0
EVENT FLASH STATUS	Yes
TBAR STATUS	Yes
PROGRAM NAMES	BPS (Command File), BPSA,BPSB,BPSB1,BPSC

2.6.5. Anthropometry Records

These sample records are the result of an ordinary BASIS DISPLAY. The selected records represent human subjects who were participants in the tests described by the records in Section 2 6 2. All Anthropometry data is in metric units

Item 1

FILE NUMBER	008
ACCESSION NUMBER	1352
DATE OF LAST UPDATE	87/07/14
SUBJECT ID	F-2
PROTOCOLS	79-06, 80-01, 80-23, 80-37, 80 40, 81-40, 82-07
MEASUREMENTS DATE	800115
AGE AT MEASUREMENTS	23
DATE OF BIRTH	550715
SEX	M
WEIGHT KG	72 1
HEIGHT, CM	170 4
SITTING HEIGHT, CM	95 2
CERVICALE HEIGHT	144 1
HEAD BREADTH	14 7
HEAD CIRCUMFERENCE	55 5
HEAD LENGTH	11 3
NECK CIRCUMFERENCE	36 0
CHEST CIRCUMFERENCE	91 6
MID-SHOULDER HT, SITTING	66 8
SUBSCAPULAR SKINFOLD	1 4
TENTH RIB BREADTH	28 0
TENTH RIB CIRCUMFERENCE	80 3
TENTH RIB HEIGHT	106 6
WAIST BREADTH	30 9
WAIST CIRCUMFERENCE	86 0
ACROMION RADIALE LENGTH	30 0
AXIL Y ARM CIRCUM	31 8
BICE CUM, FLEXED	31 6
ELBOW CIRCUM, EXTENDED	24 7
ELBOW-GRIP LENGTH	32 6
ELBOW REST HT, SITTING	30 6
HAND BREADTH	7 5
HAND CIRCUMFERENCE	18 6
HAND LENGTH	18 0
META III DACTYLION LNGTH	9 7
MID FOREARM CIRCUM	21 3
RADIALE-STYLION LENGTH	24 5
SHOULDER ELBOW LENGTH	33 0
TRICEPS SKINFOLD	1 25
WRIST CIRCUMFERENCE	14 5
WRIST BREADTH	106 6

ANT-SUP ILIAC SPINE HT	90 8
BUTTOCK CIRCUMFERENCE	98 0
GLUTEAL FURROW HEIGHT·	74 0
HIP BREADTH, SITTING	38 3
ILIAC CREST HEIGHT	96 2
SUPRAILIAC SKINFOLD	3 55
TROCHANTERION HEIGHT	84.9
ANKLE CIRCUMFERENCE	21 2
BUTTOCK-KNEE LENGTH	57 8
CALF CIRCUMFERENCE	38 2
CALF DEPTH:	11.8
FOOT LENGTH.	25 7
KNEE HEIGHT, SITTING	51 0
MID-THIGH CIRCUMFERENCE	57 2
SPHYRION HEIGHT	6 5
TIBIALE HEIGHT.	41 7
UPPER THIGH CIRCUM	60 9
LAT MALLEOLUS HT·	24 5

Item 2

FILE NUMBER:	008
ACCESSION NUMBER	1357
DATE OF LAST UPDATE:	86/08/12
SUBJECT ID	C-1
PROTOCOLS	81-40, 82-07
MEASUREMENTS DATE.	820201
AGE AT MEASUREMENTS·	26
DATE OF BIRTH	550716
SEX	M
WEIGHT, KG	76 2
HEIGHT, CM·	177 4
SITTING HEIGHT, CM	95 6
CERVICALE HEIGHT:	151 9
HEAD BREADTH	15 4
HEAD CIRCUMFERENCE	58 8
HEAD LENGTH	20 8
NECK BREADTH	12.1
NECK CIRCUMFERENCE	37.7
ACROMION HEIGHT, SITTING	63.6
BIACROMIAL BREADTH	39.8
BIDELTOID BREADTH	47 7
CHEST CIRCUMFERENCE	95 0
MID-SHOULDER HT, SITTING	66 7
SUBSCAPULAR SKINFOLD	1 24
TENTH RIB BREADTH	28.4
TENTH RIB CIRCUMFERENCE	81.3
TENTH RIB HEIGHT	113 6
WAIST BREADTH	30 3
WAIST CIRCUMFERENCE	84 2
ACROMION-RADIALE LENGTH	33 9
AXILLARY ARM CIRCUM:	33 1
BICEPS CIRCUM, FLEXED:	31 6
ELBOW CIRCUM, EXTENDED	25 8
ELBOW-GRIP LENGTH	36 0
ELBOW REST HT, SITTING	27 0
FUNCTIONAL REACH	81 0
FUNCTIONAL REACH, EXT	87 6
HAND BREADTH	9.0
HAND CIRCUMFERENCE.	31 3
HAND LENGTH·	19 5
META III-DACTYLION LNGTH	9 8
MID-FOREARM CIRCUM.	23 6
RADIALE-STYLION LENGTH	27 8

SHOULDER-ELBOW LENGTH	37 0
TRICEPS SKINFOLD	0 96
WRIST CIRCUMFERENCE·	16 5
WRIST BREADTH	113 6
ANT-SUP ILIAC SPINE HT	89 7
BUTTOCK CIRCUMFERENCE·	96 9
GLUTEAL FURROW HEIGHT	79 0
HIP BREADTH, SITTING	37 1
ILIAC CREST HEIGHT:	104.9
SUPRAILIAC SKINFOLD	3 03
TROCHANTERION HEIGHT:	91 9
ANKLE CIRCUMFERENCE	22 5
BUTTOCK-KNEE LENGTH	58 8
CALF CIRCUMFERENCE	38 6
CALF DEPTH:	12 2
FOOT LENGTH.	27 2
KNEE HEIGHT, SITTING	54.9
MID-THIGH CIRCUMFERENCE.	53 4
SPHYRION HEIGHT·	7 3
TIBIALE HEIGHT	48 0
UPPER THIGH CIRCUM	58 9
LAT MALLEOLUS HT	27 8

Item 3

FILE NUMBER·	008
ACCESSION NUMBER.	1373
DATE OF LAST UPDATE	87/07/15
SUBJECT ID·	J-3
PROTOCOLS	81-40, 82-07
MEASUREMENTS DATE	820727
AGE AT MEASUREMENTS	27
DATE OF BIRTH	550723
SEX·	M
WEIGHT, KG	79 4
HEIGHT, CM.	178.7
SITTING HEIGHT, CM·	91.8
CERVICALE HEIGHT	153 6
HEAD BREADTH.	15 0
HEAD CIRCUMFERENCE:	55 8
HEAD LENGTH·	19.6
NECK BREADTH	12.4
NECK CIRCUMFERENCE.	37.6
ACROMION HEIGHT, SITTING	60.7
BIACROMIAL BREADTH	41 7
BIDELTOID BREADTH:	48 9
CHEST CIRCUMFERENCE:	99.6
MID-SHOULDER HT, SITTING	64.6
SUBSCAPULAR SKINFOLD	1.65
TENTH RIB BREADTH.	30 8
TENTH RIB CIRCUMFERENCE:	86 0
TENTH RIB HEIGHT:	113 6
WAIST BREADTH:	32 1
WAIST CIRCUMFERENCE	88 4
ACROMION-RADIALE LENGTH	31 9
AXILLARY ARM CIRCUM	35 5
BICEPS CIRCUM, FLEXED	34 8
ELBOW CIRCUM, EXTENDED.	27 8
ELBOW-GRIP LENGTH·	34 9
ELBOW REST HT, SITTING	26 9
FUNCTIONAL REACH	82 3
FUNCTIONAL REACH, EXT	89 4
HAND BREADTH·	8 4
HAND CIRCUMFERENCE	20 9

HAND LENGTH	18.6
META III-DACTYLION LNGTH	9 6
MID-FOREARM CIRCUM	25.0
RADIALE-STYLION LENGTH	27 2
SHOULDER-ELBOW LENGTH	35 9
TRICEPS SKINFOLD	1 68
WRIST CIRCUMFERENCE	18 1
WRIST BREADTH	113 6
ANT-SUP ILIAC SPINE HT·	101 5
BUTTOCK CIRCUMFERENCE	98.0
GLUTEAL FURROW HEIGHT	82.1
HIP BREADTH, SITTING	37 9
ILIAC CREST HEIGHT:	106 9
SUPRAILIAC SKINFOLD.	3 45
TROCHANTERION HEIGHT:	95 3
ANKLE CIRCUMFERENCE	22 5
BUTTOCK-KNEE LENGTH	62 4
CALF CIRCUMFERENCE	37 6
CALF DEPTH	11 5
FOOT LENGTH	25 5
KNEE HEIGHT, SITTING	53 2
MID-THIGH CIRCUMFERENCE	53 9
SPHYRION HEIGHT	6 8
TIBIALE HEIGHT	47.7
UPPER THIGH CIRCUM	60.5
LAT MALLEOLUS HT:	27 2

Item 4

FILE NUMBER	008
ACCESSION NUMBER	1386
DATE OF LAST UPDATE·	87/07/14
SUBJECT ID	G-2
PROTOCOLS·	79-06, 80-01, 80-23, 80-37, 80-40
MEASUREMENTS DATE	791204
AGE AT MEASUREMENTS	23
DATE OF BIRTH	561105
SEX·	F
WEIGHT, KG:	53 1
HEIGHT, CM:	159 7
SITTING HEIGHT, CM.	84.7
CERVICALE HEIGHT	138 2
HEAD BREADTH	14 3
HEAD CIRCUMFERENCE	54 7
HEAD LENGTH	18.7
NECK BREADTH:	10.4
NECK CIRCUMFERENCE	32 6
CHEST CIRCUMFERENCE	89.7
MID-SHOULDER HT, SITTING:	58 9
TENTH RIB BREADTH	24 5
TENTH RIB CIRCUMFERENCE	69 6
TENTH RIB HEIGHT:	103 8
WAIST BREADTH	28 8
WAIST CIRCUMFERENCE:	78.9
ACROMION-RADIALE LENGTH	30.1
AXILLARY ARM CIRCUM:	27.8
BICEPS CIRCUM, FLEXED:	25 2
ELBOW CIRCUM, EXTENDED·	22 0
ELBOW REST HT, SITTING	22 8
HAND BREADTH	7.4
HAND CIRCUMFERENCE	17 0
HAND LENGTH.	16 6
META III-DACTYLION LNGTH:	8 5
MID-FOREARM CIRCUM	17.7

RADIALE-STYLION LENGTH	21 5
TRICEPS SKINFOLD	1 7
WRIST CIRCUMFERENCE·	13.6
WRIST BREADTH	103 8
ANT-SUP ILIAC SPINE HT	89 9
BUTTOCK CIRCUMFERENCE:	92 6
GLUTEAL FURROW HEIGHT	72.8
HIP BREADTH, SITTING.	35 3
ILIAC CREST HEIGHT	96 3
SUPRAILIAC SKINFOLD	1 0
TROCHANTERION HEIGHT:	82 0
ANKLE CIRCUMFERENCE	20.1
BUTTOCK-KNEE LENGTH	56 4
CALF CIRCUMFERENCE	33 1
CALF DEPTH	9.9
FOOT LENGTH	22 8
KNEE HEIGHT, SITTING.	47 6
MID-THIGH CIRCUMFERENCE	47 8
SPHYRION HEIGHT:	6 5
TIBIALE HEIGHT.	44.6
UPPER THIGH CIRCUM	55.0
LAT MALLEOLUS HT.	21 5

2.6.6. Bibliography Records

The following represents the results of an ordinary BASIS DISPLAY command, operating on a small set of Bibliography records

Item 1

FILE NUMBER:	020
ACCESSION NUMBER.	10612
DATE OF LAST UPDATE	88/10/25
TITLE	Physical Characteristics of Aircraft Noise Sources
AUTHOR(S)	H E. von Gierke
CITATION	Journal of the Acoustical Society of America, 25(3) 367-378, May 1953 (Symposium on Aircraft Noise, San Diego CA, 13-15 May 1953)
SOURCE (CORP/INST)	Aero Medical Laboratory, Wright-Patterson AFB OH
PUBLICATION DATE	530500
TOTAL PAGES:	12
ABSTRACT	Available basic characteristics of different aircraft noise sources under the condition of zero forward speed are summarized The changes in the characteristics of the noise generators during flight are discussed briefly
LOCAL AVAILABILITY	VG
ORIGINAL INPUT BY:	OD(Katz)
ORIGINAL INPUT ON:	870501
FIRST AUTHOR:	VONGIERKEhe

Item 2

FILE NUMBER:	020
ACCESSION NUMBER:	11352
DATE OF LAST UPDATE·	88/11/14
TITLE:	The Jaw Motions Relative to the Skull and their

AUTHOR(S): Ernst K Franke, Henning E von Gierke, Wolf W von Wittern

CITATION: Journal of the Acoustical Society of America, 24(2) 142-146, Mar 1952

SOURCE (CORP/INST): Aero-Medical Laboratory, Wright-Patterson AFB OH

PUBLICATION DATE: 520300
TOTAL PAGES: 5
ABSTRACT: Opening and closing the mouth increases the sound pressure produced by bone conduction in the closed auditory canal by as much as six to ten decibels in the frequency range between 40 cps and 700 cps This difference is explained by variations of the lower jaw relative to the skull. The resonance curve of this motion was measured and used to calculate the influence of the lower jaw motion of the sound level in the closed auditory canal The results show that the measured frequency response of the difference in sound pressure open mouth vs closed mouth, may be explained entirely by vibrations of the lower jaw

LOCAL AVAILABILITY: BB, VG

IDENT CODES: AF Technical Paper 6466

ORIGINAL INPUT BY: OD(Abrams)
ORIGINAL INPUT ON: 870501
FIRST AUTHOR: FRANKEernstk

Item 3

FILE NUMBER: 020
ACCESSION NUMBER: 13019
DATE OF LAST UPDATE: 88/11/14
TITLE: Impact Tests of Automatic Lap Belt Configurations

AUTHOR(S): J W. Brinkley, D E Schimmel

CITATION: AFAMRL-TR-84-041

SOURCE (CORP/INST): AF Aerospace Medical Research Laboratory, Wright-Patterson AFB OH

PUBLICATION DATE: 840702
TOTAL PAGES: 104
ABSTRACT: Sixteen impact tests of lap belt assemblies were performed to evaluate components for the HBU-X lap belt (not designated the HBU-12 lap belt). The lap belt assemblies were tested as part of a lap belt and shoulder harness configuration. Fifteen tests were conducted at a level of 40 G (mean=40 2 G, SD=0 898) with an average impact velocity of 105.7 fps (SD=0.976) The impact vector was applied in the -Gx direction. The primary purpose of the tests was to evaluate the effectiveness of two differnet types of webbing adjusters. The influence of nylon, polyester, and latex-impregnated polyester was also studied The results of the impact tests and several modes of failure including belt slippage through the adjusters and fractures of the metal attachment link of the MB-6 shoulder harness are described Revision of design and test conditions are recommended

LOCAL AVAILABILITY: BB

IDENT CODES: DTIC-ADA148034

EXPRMTS (PARENT) ACCN NO·	3367
ORIGINAL INPUT BY:	OD(Abrams)
ORIGINAL INPUT ON	870501
FIRST AUTHOR	BRINKLEYjw

Item 4

FILE NUMBER.	020
ACCESSION NUMBER	13021
DATE OF LAST UPDATE	88/11/14
TITLE	Impact Tests of Adjusters for the HBU-12 Lap Belt
AUTHOR(S)	D E Schimmel, J W Brinkley
CITATION	AFAMRL-TR-84-053
SOURCE (CORP/INST)	AF Aerospace Medical Research Laboratory, Wright-Patterson AFB OH
PUBLICATION DATE	840826
TOTAL PAGES·	53
ABSTRACT	Impact tests were performed to evaluate the adequacy of 1-3/4-in webbing adjusters proposed for the HBU-12 automatic lap belt Four tests were conducted at impact levels ranging from 41 8 to 43 7 with impact velocities ranging from 84 9 to 86 7 fps, using the AF Medical Research Lab's horizontal decelerator facility with anthropometric dummy subjects The adjusters were installed on the HBU-12 lap belt and tested with an MB-6 double shoulder harness During the first impact test, the metal clevis of the shoulder harness failed at its attachment point But the lap belt and adjusters sucessfully withstood the impact loads The subsequent three tests were were completely successful
LOCAL AVAILABILITY·	BB
IDENT CODES	DTIC-ADA148021
EXPRMTS (PARENT) ACCN NO·	3322
ORIGINAL INPUT BY.	OD(Abrams)
ORIGINAL INPUT ON	870501
FIRST AUTHOR	SCHIMMELdc

2.6.7. Study (Parent) Extension Records

The following items are the extensions of the parent records displayed in Section 2 6.1. They were generated with an ordinary BASIS DISPLAY Command. Information in parentheses is extra and explanatory; it appears on this record but will not be picked up by the run module and included as part of the label affixed to Test Log data.

Item 1

FILE NUMBER.	005
ACCESSION NUMBER·	1663
DATE OF LAST UPDATE.	88/01/14
PARENT ACCN NO·	1
GENRL VARIABLES·	F4E001 TEST NUMBER F4E002: PARENT ACCN NO F4E006· NOTES
MECHAN VARIABLES	F4E109: RESTRAINT TYPE F4E151. EVENT DURATION, mS F4E152: PEAK ACCEL, G F4E153: OBJCTV PEAK G

	F4E154 OBJCTV IMPCT VEL, FPS
	F4E177 DROP HT/SLED TRAVL, FT (VDT/HIA)
	F4E180 SLD BRK PR, CORNR, PSIG (HIA)
	F4E181 SLD BRK PR, CENTR, PSIG (HIA)
	F4E182 SET PRESSURE, PSIG (HIA)
	F4E183 LOAD PRESSURE, PSIG (HIA)
	F4E184 TRIGR PRESSURE, PSIG (HIA)
	F4E188 RAM DISPLCMNT, IN (HIA)
MECHAN CONSTANTS	F4E094 PLUNGER NO/METERING PIN (VDT/HIA)
	F4E111 RSTRNT ATTCHMT LOCTNS
	F4E120 OTHER PROTCTV GEAR
	F4E128 SEAT ASSMBLY DRWNG NO
	F4E129 SEAT TYPE
	F4E132 HEADREST POSITION
	F4E149 WAVEFORM
	F4E174. SEAT PAN INCLIN, DEG (HIA)
	F4E175. SEAT BACK ANGLE, DEG
	F4E185 H2O HT/SET VOL L, IN (VDT/HIA)
	F4E186 ORIF DIAM/LOAD VOL L, IN (VDT/HIA)
PHOTO VARIABLES:	F4E350 CAMERA1 LENS SIZE, mm (HIA, remaining camera1 info is constant)
PHOTO CONSTANTS	F4E312 DC ONBD CMRAS, STATUS
	F4E313 TIMING AUX INFO
	F4E332 FIDUCIAL LOCATIONS
	F4E350 CAMERA1 LOC, DESCRIP
	F4E351 CAMERA2 LOC, DESCRIP
	F4E356 LED DRIVR, AC FIXD CAMRA (HIA)
	F4E357 LED DRIVR, DC FIXD CAMRA
ELECT CONSTANTS	F4E410 CHANNEL ASSMTS
	F4E411 TRANSDCR IDs, SENS, FS
	F4E412 TRANSDCR ZEROS, RANGES
	F4E414 EXCITATION VOLTS
	F4E416 FILTER IDs, SENS
	F4E418 SAMPLE RATES
	F4E420: AMPLIFR IDs, GAINS
	F4E421: BRIDGE RESISTR INFO
	F4E425: NOTES, PROBLMS (electronics)
	F4E427 COMPUTER ON, OFF
	F4E429 FACILITY ON, OFF
DATA LINK VARIABLES	F4E510 PHOTO TAPE, FILE NOS
	F4E513 NO FRAMES PROCESSD (HIA, both cameras)
	F4E514: NO FRAMES FR EVENT (both cameras)
	F4E530 REFERENCE MARK, mS
	F4E531 TIME IMPACT START, mS
DATA LINK CONSTANTS	F4E513 NO FRAMES PROCESSD (VDT, both cameras)
	F4E515 NO FRAMES FR TBAR (timing bar)
	F4E517 EVENT FLASH STATUS
	F4E518 TBAR STATUS
	F4E520 PROGRAM NAMES

Item 2

FILE NUMBER:	005
ACCESSION NUMBER:	2415
DATE OF LAST UPDATE:	88/01/14
PARENT ACCN NO	531
GENRL VARIABLES	F4E001 TEST NUMBER
	F4E002: PARENT ACCN NO

	F4E006 NOTES
MECHAN VARIABLES	F4E152 PEAK ACCEL, G F4E167 AVG REEL STRP ANGLE, DEG (avg of right and left, differing 0-3 degrees) F4E173 SEAT HT, IN
MECHAN CONSTANTS	F4E094 PLUNGER NO F4E109 RESTRAINT TYPE F4E111 RSTRNT ATTCHMT LOCTNS F4E120 OTHER PROTCTV GEAR F4E128 SEAT ASSMBLY DRWNG NO F4E129 SEAT TYPE F4E132 HEADREST POSITION F4E149 WAVEFORM F4E153. OBJCTV PEAK G F4E154 OBJCTV IMPCT VEL, FPS F4E175 SEAT BACK ANGLE, DEG F4E177 DROP HT, FT F4E185 H2O HT, IN F4E186 ORIF DIAM, IN
PHOTO CONSTANTS	F4E332 FIDUCIAL LOCATIONS F4E350 CAMERA1 LOC, DESCRIP F4E351 CAMERA2 LOC, DESCRIP
ELECT CONSTANTS	F4E410 CHANNEL ASSMTS F4E411: TRANSDCR IDs, SENS, FS F4E412 TRANSDCR ZEROS, RANGES F4E414 EXCITATION VOLTS F4E416 FILTER IDs, SENS F4E418 SAMPLE RATES F4E420. AMPLIFR IDs, GAINS F4E421 BRIDGE RESISTR INFO F4E425 NOTES, PROBLMS (electronics) F4E427 COMPUTER ON, OFF F4E429 FACILITY ON, OFF
DATA LINK VARIABLES	F4E510 PHOTO TAPE, FILE NOS (right side camera)
DATA LINK CONSTANTS	F4E513 NO FRAMES PROCESSD (right side camera) F4E514 NO FRAMES FR EVENT (right side camera) F4E515 NO FRAMES FR TBAR (timing bar, right side camera) F4E517 EVENT FLASH STATUS F4E518 TBAR STATUS F4E520 PROGRAM NAMES

2.6.8. Anthropometric Measurements Directory

This is the only record in the Biodynamics Data Bank with the file number 007 The following display of the entire record is the result of an ordinary BASIS DISPLAY command

FILE NUMBER	007
ACCESSION NUMBER	1326
DATE OF LAST UPDATE.	87/07/06
GENERAL ATTRIBUTES	Subject ID SUBJID Protocols (human use protocols which describe subject's participation)
PRTCLS	
	Measurement Date MEASDA Age (on day measurements taken) AGE Date of Birth DOB

	Sex SEX Weight, kg WT Height, cm HT Sitting Height, cm· SITHT
HEAD-NECK:	Aorta-Eye Length HEAD1 Cervicale Height HEAD2 Chin/Neck Height HEAD17 Eye Height: HEAD3 Eye Height, Sitting HEAD4 Eye Height, Sitting, Up. HEAD5 Eye Height, Sitting, Down HEAD6 Head Breadth HEAD7 Head Circumference HEAD8 Head Length (glabella to occiput in midsagittal plane) HEAD9 Head Top-Tragion Length HEAD18 Infraorbitale-Nuchale Length, Proj X-Z HEAD10 Infraorbitale-Tragion Length (Tragion is cartilaginous notch just forward of upper edge of ear), Proj X-Z HEAD11 Mastoid Height: HEAD12 Neck Breadth HEAD13 Neck Circumference HEAD14 Nuchale-T1 Length, Proj X-Z HEAD15 Tragion-T1 Length (Tragion is cartilaginous notch just forward of upper edge of ear.), Projection X-Z HEAD16 Wall-Tragion Length HEAD19
UPPER TORSO	Acromion Height UPTOR1 Acromion Height, Sitting UPTOR2 Aorta Height: UPTOR14 Biacromial Breadth. UPTOR3 Bideltoid Breadth: UPTOR4 Chest Breadth UPTOR15 Chest Circumference UPTOR5 Chest Depth: UPTOR6 Mid-Shoulder Height, Sitting UPTOR7 Shoulder Circumference· UPTOR17 Subscapular Skinfold UPTOR8 Suprasternal Height UPTOR16 Tenth Rib Breadth UPTOR9 Tenth Rib Circumference UPTOR10 Tenth Rib Height UPTOR11 Waist Breadth: UPTOR12 Waist Circumference UPTOR13
ARM-HAND	Acromion-Dactylion Length ARM19 Acromion-Radiale Length ARM1 Axillary Arm Circumference ARM2 Biceps Circumference, Flexed. ARM3 Dactylion Height (tip of middle finger to standing surface) ARM4 Elbow Breadth ARM22 Elbow Circumference, Extended ARM5 Elbow-Grip Length (horizontal distance from olecranon process to center of gripped pencil) ARM6 Elbow Rest Height, Sitting· ARM7 Functional Reach (Thumb Tip Reach) ARM8 Functional Reach, Extended. ARM9 Hand Breadth: ARM10 Hand Circumference ARM11 Hand Length (wrist landmark to tip of longest finger) ARM12 Humerus Ball-Radiale Length ARM20 Meta III-Dactylion Length (Meta III to tip of middle finger) ARM13 Mid-Forearm Circumference: ARM14 Radiale-Stylion Length ARM15

Shoulder-Elbow Length (acromion to olecranon process) ARM16
Thumb Tip Reach (Functional Reach) ARM8
Thumb Tip Reach, Extended ARM9
Triceps Skinfold ARM17
Wrist Breadth ARM21
Wrist Circumference ARM18

LOWER TORSO.

Anterior-Superior Iliac Spine Height LOTOR1
Bispinous Breadth (distance between right and left anterior superior iliac spine landmarks)· LOTOR8
Buttock Circumference LOTOR2
Gluteal Furrow Height. LOTOR3
Hip Breadth, Sitting LOTOR4
Iliac Crest Height LOTOR5
Suprailiac Skinfold LOTOR6
Trochanterion Height LOTOR7

LEG-FOOT

Ankle Circumference: LEG1
Buttock-Knee Length (horizontal distance from rearmost surface of buttock to front surface of kneecap, sitting) LEG2
Calf Circumference LEG3
Calf Depth LEG4
Femur Breadth· LEG12
Foot Length LEG5
Knee Height (footrest to suprapatella, sitting) LEG6
Malleolus, Lateral, Height LEG11
Mid-Thigh Circumference LEG7
Sphyrion Height (footrest to end of tibia on medial side below ankle malleolus) LEG8
Tibiale Height: LEG9
Upper Thigh Circumference (at level of lowest point on gluteal furrow, standing): LEG10

2.7. Examples of Use

The following cases show how the BDB has been used so far:

(1) A facility engineer wanted to identify tests run on the Horizontal Impulse Accelerator where a certain metering pin was used and a certain peak G and impact velocity was reached. He began the BASIS session with a request for a set of Test Log records having those criteria (that is, the test number beginning with HIA, the metering pin number equal to the one specified, and the peak G and velocity equal to or greater than those specified). From this set he selected tests whose input and output parameters could be retrieved and analyzed or used to recreate the test conditions for a repeat run.

(2) Investigators testing biodynamics models needed peak head and chest accelerations in all three translational axes for horizontal impact tests of greater than 9 G where the subject was a male with specific 90-95th percentile dimensions wearing a specific type of restraint. The Study file was used first to identify large groups of tests likely to fulfil the horizontal impact and restraint type criteria. Confirming information on the type of restraint used was found in the common Test Log records for those studies selected as being most promising. Tests from those studies with subjects who fulfilled the size requirement and where the G level was 9 or greater were identified from the Test Index children without having to cross-reference the Anthropometry file, because

subject height, weight and sitting height are Test Index variables also. When the proper set of tests was identified, the Test Data twins of those records yielded the peak head and chest acceleration data required.

(3) Tables of specific anthropometric measurements-- height, weight, sitting height, mid-shoulder sitting height, buttock-knee length and knee height, e.g.-- have been generated for a selected few, or for all, human subjects represented in the BDB. When requested, BASIS also calculated the means, medians, standard deviations, etc. for each column.

(4) A facility engineer used the Study record of an experiment investigating the effect of varying rise times on impact acceleration response to identify test cells having rise times, objective peak G and objective maximum velocities of interest. Then he generated a table from a selected set of Test Index records, sorted according to subject type and showing the test number, cell, date, weight of subject, actual peak G, actual maximum velocity, duration of impact and rise time for each test.

(5) A researcher was preparing to analyze the effects of acceleration impact on female pilots and special considerations thereof. She generated printouts from the BDB of study and test data from the 91 tests currently represented there (encompassing 6 different studies) where the subject was a human female.

(6) An unusual request from a biodynamics researcher interested in human impact test results where no accelerometer mouth pack was used was answered efficiently. It was quickly determined, from data in the Study records, that human subjects used mouth packs in all studies currently represented in the BDB.

(7) A project engineer needing to identify high G level tests done on the Horizontal Impact Accelerator where the impact profile was produced with a specific metering pin used the Test Log file to identify studies where all tests were run with that metering pin. Then, using those family names and a peak G greater or equal to 9.8 as criteria, he generated a table of Test Index data showing test number, date, subject type, peak G, and maximum velocity for those tests, sorted in ascending peak G order.

In all cases, either the information required was itself in the data bank, or a specific set of tests was identified according to distinctive criteria so that the correct files of raw data could be retrieved and complete time histories generated for further analysis.

3. CONCLUSIONS and RECOMMENDATIONS

The AAMRL Biodynamics Data Bank is functional and contains a critical mass of data. It has already proven itself useful to a wide variety of biodynamics researchers.

The flexibility of its design has also been tested, since the 27 studies now represented in the BDB cover more than 15 years of evolving research emphases, where a variety of impact test facilities have been used to test a variety of hypotheses. No two studies have exactly the same set of variables in any of the different record types, yet the BDB accomodates them and, where sensible, cross-study sets of tests can be identified for further analyses and different purposes.

Still, the AAMRL Biodynamics Data Bank has not yet reached its final development nor fulfilled its complete potential; it is useful, but it is not as useful as it could be. "The finishing touches" should address the following priorities.

3.1. BDB Content

Current content, both qualitative and quantitative, has been addressed in detail in Sections 2.2. and 2.4. Qualitatively, while minor alterations may occur as the mission of biodynamics impact acceleration experiments changes, or as the use of the BDB for storage and retrieval of other types of biodynamics data broadens, no major alterations or additions are envisioned. *Quantitatively* however, the numbers speak for themselves. If the AAMRL Biodynamics Data Bank is to reach its full potential-- the uses envisioned by Dr. Henning von Gierke in 1977 and endorsed by the National Research Council CHABA Working Group a few years later-- more data must be incorporated into it. The data for completed experiments and relevant literature should be put into the BDB, and more efficient inputting processes should be developed for newly generated data, both experimental and bibliographic.

Additionally, AAMRL has impact acceleration data from earlier experiments (1958 to 1972) that is considered valuable to ongoing research in impact protection It should be inventoried and evaluated for completeness and quality and prioritized by overall importance of work to the state of the art. Then, methods and procedures for converting it to BDB format should be developed and implemented.

3.2. Input and Verification Procedures

Current input procedures are heavily dependent on keyboard input after assembling BDB data from various sources by hand. As such, they are labor intensive, time consuming, error prone, and costly. While a substantial amount of keyboard entry and editing will continue to be necessary for certain record types, the input process should be automated as much as possible.

Test Data records are created completely electronically now, that is, through programs which convert the data after processing from a storage format to a BASIS batch-input format. Part of the Test Index record is also created this way. But much more could be done, depending on resources available, to "log in" the data electronically at the research site as files which could be converted electronically into BDB BASIS format. This would avoid much of the paperwork and keyboard entry now used to input BDB data. Bibliography citations may be downloaded from other AAMRL bibliographic

databases as published literature evolves from AAMRL research, or be input by branch clerical personnel as libraries grow.

At the current time newly input BDB data is verified electronically only at the most fundamental level. The BASIS utility routines which convert batch or keyboard input to on-line format check for correct data type (i.e., Real, Integer or String) and disallow records with incorrect data types and those with invalid or duplicate field identifications. All specific validation-- range checks for numeric data and all consistency checks-- must be done "by hand".

Verification programs *with field-by-field specificity* should be written for each file and used on all new BDB data before it becomes a permanent part of the database, to

(1) disallow and flag inappropriate or out-of-range data;

(2) ascertain that certain critical fields have data,

(3) check for consistency of data between or among fields within a record; and

(4) check for consistency of data among related record types.

3.3. User-Friendly Enhancements

In general, the more flexibility and the more display options a data base management system offers, the more information the user must absorb and retain to use it effectively, and the more cumbersome the keyboard retrieval commands will be, *unless* applications are developed within the DBMS language specific to the database contents and use. The BDB's design manipulates the BASIS system, offering much more flexibility, but the cost is increased complexity and less user friendliness The size of the BDB-- 577 fields, many of these dimensioned into subfields-- further increases its complexity and lessens ease of access to the data.

A few applications to help in this regard have already been written-- the run module which labels Test Index data displays with actual (logical) variable names, for example, and some small "profiles" (procedure files, the BASIS name for macros) each of which, when invoked with a few easily remembered keystrokes will generate a longer more complex set of (difficult to remember) keystrokes. But more of these enhancements-- other run modules, more profiles (macros), and some standard report forms for oft-requested data-- would increase the user friendliness, and hence the effectiveness and value of the BDB.

3.4. Administrative Aids and Documentation

Besides the verification programs discussed in Section 3.2., other (computerized) administrative aids would help ensure smoother, more efficient management of the Biodynamics Data Bank. Keeping track of how the generic "slots" (fields) of the Test Index, Test Data and Test Log record types have been assigned is now done on paper spreadsheets which must be updated whenever new variables are added. Furthermore, even with the best of planning, "rearrangement" is occasionally necessary. Microcomputer programs could be used to good advantage in this respect.

Further development of documentation, for both administrators and users, is also recommended. A User's Manual for the Biodynamics Data Bank exists and will be updated in the near future [4] A short document defining the fields of the Bibliography record type and outlining input and editing conventions for that file also exists [5], but a new, comprehensive document should be developed which does likewise for *each* field and each file in the BDB. In other words, an Administrator's Manual should be written.

4. REFERENCES

1. 4 February 1980 Biodynamic Data Bank Design and Development, Section F, Request for Purchase No. FY8990-80-00026

2. Carley C. Ward, April 1980: Biodynamic Data Bank Feasibility Study (Civil Engineering Laboratory, Technical Memorandum No. 51-80-09).

3. Committee on Hearing, Bioacoustics, and Biomechanics, 1981: The Feasibility of a National Biomechanics Data Bank (Report on Working Group 87, Assembly of Behavioral and Social Sciences, National Research Council), National Academy Press .

4. Trudy S. Abrams, April 1986: Database 57 Biodynamics Data Bank User's Manual, (Systems Research Laboratories Inc., for Harry G. Armstrong Aerospace Medical Research Laboratory Biodynamics and Bioengineering Division.)

5. Trudy S. Abrams, August 1988: B57 BIBLIO File Field Definitions and Editing Conventions. (Systems Research Laboratories Inc., for Harry G. Armstrong Aerospace Medical Research Laboratory Biodynamics and Bioengineering Division.)